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TANKS OF SOUTH INDIA

Edited by **A Vaidyanathan**

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Cover photo: A satellite image capturing the profusion of tanks in Ramanathanpuram. The blue spots indicate the hundreds of *eries* or tanks of various sizes, spread out in an elaborate network
Credit: National Remote Sensing Agency

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41, Tughlakabad Institutional Area, New Delhi-110 062
Phones: 608 1110, 608 1124, 608 3394, 608 6399 Fax: 91-11-608 5879
Email: cse@cseindia.org Website: www.cseindia.org

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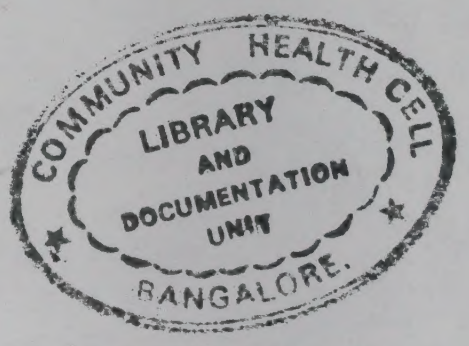

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ABBREVIATIONS

AE	Assistant Engineer
AEE	Assistant Executive Engineer
AP	Andhra Pradesh
BC	Branch Canal
CBIP	Central Bureau of Irrigation and Power
CE	Chief Engineer
CI	Cropping Intensity
DMT	Dusi Mamandur Tank
EE	Executive Engineer
FRL	Full Reservoir Level
FTL	Full Tank Level
GCA	Gross Cropped Area
GOAP	Government of Andhra Pradesh
GOI	Government of India
GOK	Government of Karnataka
GOTN	Government of Tamil Nadu
GVO	Gross Value Output
HHs	Households
HR	Head Reach
IB	Irrigation Board
IC	Inlet Channel
IIs	Irrigation Institutions
JE	Junior Engineer
KG	Kilogram
KM	Kilometre
KPT	Kaveripakkam Tank
LA	Less Active
MCFT	Million Cubic Feet
MR	Middle Reach
MSL	Mean Sea Level
NIA	Net Irrigated Area
NSA	Net Sown Area
OMP	Oru Madai Paichal
PAS	Palar *Anicut* System
PMC	Periyar Main Canal
PVB	Periyar Vaigai Basin
PVC	Periyar Vaigai Canal
PVS	Periyar Vaigai System
PWD	Public Works Department
RBT	Ramnad Big Tank
SDO	Sub-Divisional Officer
TMC	Thirumangalam Main Canal
TN	Tamil Nadu
TR	Tail Reach
TRS	Tank Restoration Scheme
VAO	Village Administrative Officer
WI	Work Inspector
WSA	Water Spread Area
PMT	Pasumpon Muthuramalinga Thevar

Chapter 1

INTRODUCTION

A Vaidyanathan

India has a long tradition of using small storages (man-made and natural) and diversion works for irrigating crops. These works, found throughout the country, are among the most important and widespread traditional devices of water harvesting dating back several centuries. Tanks and ponds are used for a variety of purposes: as a source of water for drinking, washing and bathing for humans and animals, for irrigating crops and for raising fish. Traditionally silt from the tankbeds was used for improving fertility of agricultural land; trees grown on the tank *bunds* are a source of small timber and domestic fuel. Sustain as they do a wide variety of both aquatic and bird life, tanks also play an important role in the ecological system and help maintain biological diversity.

Until the advent of large reservoir-based systems, most of the irrigation consisted of small storages, local diversion canals drawn from streams and rivers and shallow wells. Modern engineering concepts and techniques were first used in the modernisation and improvement of the old deltaic irrigation networks of major south Indian rivers (namely, Cauvery, Krishna, Godavari and Mahanadi). These works, which the British took up during the latter half of the 19th century as well as some large new canal irrigation works in the Indo-Gangetic plains continued to be fed by diversion of river flow with the help of low barrages. The volume of storage in these barrages relative to the volume of water used was very small. The construction of irrigation systems based on large reservoirs was taken up only in the last century. While the area under large canal systems (classified as public canals) increased substantially, the traditional local surface works were still the main sources at the time of Independence.

Thus in 1950-51 public canals irrigated 8.7 million hectares, which constituted 41 per cent of the total net area irrigated in the country. Tanks alone were reported to irrigate 4 million hectares. Tanks and "other sources" (almost all of them small local works) irrigated about 6.5 million hectares which represents 40 per cent of the total area served by surface irrigation. Groundwater drawn from shallow wells with manual and animal power irrigated 6.6 million ha.

Judging by official statistics recent decades have witnessed a significant decline in the role of tanks and other minor surface irrigation works in both relative and absolute terms. Thus during the fifties, these sources accounted for nearly 30 per cent of the country's net irrigated area, their share had fallen to a mere 12 per cent during the 1980s. Over the same period the area served by them is reported to have fallen from 6.5 million hectares to 5.5 million hectares, the decline being entirely in areas under tank irrigation *(see Table 1.1)*.

Whether or not the official statistics present an accurate picture of the ground reality is debatable because of the weaknesses in the reporting system. Nevertheless the broad trends revealed by data are consistent with impressions from the field. It is widely believed that the decline reflects the cumulative effect of long neglect of repair and maintenance. Siltation of tanks has reduced their storage capacity; degradation of catchment areas and interference of natural drainage channels by urbanisation and other development works have reduced inflow of water; and the breakdown of traditional community organisations for maintenance and management has led to the deterioration of the physical structures and distribution network, thereby reducing their effective capacity.

It is ironic that the apparent decline in minor surface irrigation works occurred during a period when the government outlays on irrigation development reached unprecedented levels. Between 1951 and 1997, public sector plan outlays on all forms of irrigation and flood control (at current prices) totalled Rs 860 billion *(Table 1.2)*. The bulk of this (Rs 590 billion) was spent on expansion and improvement of large surface irrigation

Table 1.1: Trends in Net Irrigated Area (NIA) by Sources in India from 1950-51 to 1989-90

(Area in million hectares)

Source	1950-51–1959-60		1960-61–1969-70		1970-71–1979-80		1980-81–1989-90		1989–90	
	Area	% of NIA	Area	% of NIA	Area	% of NIA	Area	% of NIA	Area	% of NIA
Government and private canals	9.186	41.2	11.189	41.9	13.768	40.1	16.314	38.3	17.06	37.0
Tanks	4.150	18.6	4.449	16.6	3.810	11.1	2.991	7.0	2.90	6.3
Wells and tubewells	6.632	29.8	8.709	32.6	14.405	41.9	20.778	48.7	23.38	50.7
Other sources	2.319	10.4	2.387	8.9	2.378	6.9	2.543	6.0	2.76	6.0
Total NIA	22.287	100.0	26.734	100.0	34.361	100.0	42.626	100.0	46.100	100.0

Source: GOI, Indian Agricultural Statistics, 1985-86 — 1989-90, Vol I, Ministry of Agriculture, New Delhi, 1992.

works. Outlays on so-called "minor" irrigation — which included both small-scale surface and groundwater irrigation schemes and added upto to Rs 223 billion — no doubt also reached unprecedented levels. Though the distribution of this outlay between minor surface irrigation and groundwater is not available, it is well known that the bulk of it went into groundwater development. Rehabilitation of existing tanks and other small local diversion and lift irrigation facilities which were badly in need of repair as well as the construction of new works in this category obviously had low priority under the plans.

That small-scale surface irrigation works are numerous, widespread and serve extensive areas is evident from *Table 1.3*. According to the Minor Irrigation Census, conducted in 1986-7, the country had over 7,50,000 minor irrigation structures using surface water. Approximately 7,00,000 of these were found to be in use. In terms of numbers, the large majority of them (68 per cent) consisted of smallscale local diversion of water or

Table 1.2: Magnitude and Composition of Investment Through Plan Periods in Irrigation and Flood Control Sectors in India, 1951-1997

(Rs in crores)

Plans	Major & medium irrigation	Minor irrigation			Command area development	Flood control	Total	Total public sector outlay
		Plan outlay	Institutional credit	Total				
I Plan 1951-56	380	66	Neg.	66	NA	14	460	460
II Plan 1956-61	380	142	19	161	NA	49	590	571
III Plan 1961-66	581	328	115	443	NA	86	1,110	995
Annual 1966-69	434	326	235	561	NA	44	1,039	804
IV Plan 1969-74	1,237	513	661	1,174	NA	172	2,583	1,922
V Plan 1974-78	2,442	631	780	1,411	122	299	4,274	3,494
Annual 1978-80	2,056	497	490	987	88	228	3,359	2,869
VI Plan 1980-85	7,516	1,802	1,438	3,240	521	596	11,873	10,435
VII Plan 1985-90	11,343	3,228	3,312	6,540	1,428	942	20,253	16,941
Annual 1990-92	5,320	1,809	NA	1,809	640	493	8,262	8,262
VIII Plan 1992-97	22,415	5,977	NA	5,977	2,510	1,623	32,525	32,525
Total 1951-97	54,104	15,319	7,050	22,369	5,309	4,546	86,328	79,278

Note: NA = Not available; Total (1951-97) excludes institutional investments of the Annual Plan (1990-92) and the Eigth Plan (1992-97); and also command area development outlays upto IV plan (1969-74).

Source: GOI, Ministry of Water Resources, Report of the Working Group on Minor Irrigation (Vol 1) and Major and Medium Irrigation (Vol 2) for Formulation of the Eighth Plan (1990-95) Proposals Constituted by the Planning Commission, New Delhi, 1989. GOI, PC, Eighth FYP, 1992-97, Vol. II, New Delhi, 1992.

Table 1.3: Statewise Distribution of Minor Irrigation Structures in India,1986-87

Sl No	Name of State	Minor surface water irrigation Structures (numbers)*				Average NIA by minor surface irrigation 1981-82 to 1985-86 ('000 ha)**
		Schemes not in use	Tanks	Schemes in use diversion plus lift	Total	
1.	Andhra Pradesh	11,690	60,745	21,659	94,094	1,017
2.	Karnataka	13,016	20,152	36,786	69,954	486
3.	Tamil Nadu	792	36,523	14,090	51,405	701
4.	Uttar Pradesh	10,755	10,810	52,693	74,258	465
5.	West Bengal	1,236	37,589	83,246	1,22,071	542
6.	Maharashtra	2,152	12,539	66,371	81,062	283
7.	Orissa	2,178	6,879	12,694	21,751	265
8.	Madhya Pradesh	7,302	15,507	68,836	91,645	386
9.	Bihar	–	–	–	–	689
10.	Kerala	1,320	4,396	55,967	61,683	142
	All India	52,777	2,08,381	4,44,983	7,06,141	5,768

Note: All India total includes data on all States and Union Territories; – : Not available.
Source: * GOI, Central Board of Irrigation and Power, Statistics of Minor Irrigation Development (1986-87), New Delhi, 1989.
** GOI, Indian Agricultural Statistics, 1981-2 to 1985-6, Vol.1, 1989.

its lifting from streams and rivers. Tanks, which are relatively small, shallow storages, constitute about a third of all minor works in use. In terms of area irrigated however, they are far more important, accounting for nearly 80 per cent of the net area by all minor surface sources. The country had an estimated 2,08,000 tanks irrigating 3.5 million hectares.

It is evident that the importance of minor surface sources as a whole and of different types of minor works varies a great deal across states. The proportion of sown area irrigated by minor surface works of all types is higher than national average in the southern and the western states and much below average in the north west and central parts of the country. Among various minor sources, tanks are dominant in the south while diversion and lifts are prominent in UP and Bihar. This study is focussed on tanks of south India.

Taking the country as a whole, tanks by themselves irrigated about 2.4 per cent of net sown area in the early 1980s and accounted for about 8 per cent of total irrigated area. By both criteria tank irrigation plays a considerably more important role in Orissa, West Bengal, Karnataka, Andhra Pradesh and Tamil Nadu. They are particularly prominent in Andhra Pradesh and Tamil Nadu *(Table 1.4)*. Uttar Pradesh, Rajasthan, Madhya Pradesh and Orissa also have substantial area under tank irrigation, but its importance as a source of irrigation (both relative to other sources and to the total cultivated area) is nowhere as great as in the south. These three states happen to account for nearly 60 per cent of the total area under tank irrigation in the country.

Except where it has been compensated by the availability of canal irrigation or groundwater, a decline in tanks and other smallscale works adversely affects a large number of dispersed communities depending on them. More importantly, many claim that small, community-managed irrigation systems are superior, both economically and ecologically, than large scale canal or groundwater irrigation. However, there are few systematic studies of the characteristics and functioning of minor systems, the extent of deterioration and their present situation. This monograph is a modest attempt at filling this gap.

On the basis of secondary data and an extensive first hand survey of nearly 80 tanks, a fuller and more detailed picture of the current state of tank irrigation in the southern region - the validity of perceptions of their deterioration and of the organisation and working of the institutional arrangements for their management - is now possible. The institutional aspects are of special interest because tanks are known to have a long tradition of collective action by beneficiary communities. How exactly and how effectively they have adapted to changes in technology and agrarian structure is a matter of considerable importance in the context of the recent revival of important in decentralised, community managed systems of natural resource management.

We start in Chapter 2 with a description of the main features of and recent trends relating to tank

Table 1.4: Statewise Net Area Irrigated by Sources in India, 1981-82 - 1985-86

(Area in '000 ha)

Sl No	Name of State	NSA 1981-82 to 1985-86	Net area irrigated by (1981-2 to 1985-6)				% of NIA	% of NIA by tanks to total NSA	% of NIA by tanks to total NIA
			Tanks	Canals	Wells	Other sources	Total		
1.	Andhra Pradesh	12,704.2	909.0	1,783.0	831.6	108.4	3,632.0	7.2	25.0
2.	Karnataka	10,414.6	299.8	657.2	440.0	186.2	1,583.2	2.9	18.9
3.	Tamil Nadu	5,666.4	690.0	840.2	993.4	21.2	2,544.8	12.2	27.1
4.	Uttar Pradesh	17,256.8	155.8	3,304.4	6,153.8	308.8	9,922.8	0.9	1.6
5.	West Bengal	5,030.6	290.6	694.6	641.6	251.2	1,878.0	5.8	15.5
6.	Maharashtra*	18,247.8	282.6	849.6	1,103.6	NA	2,235.8	1.5	12.6
7.	Rajasthan	15,650.2	130.0	1,060.4	1,793.6	38.2	3,022.2	0.8	4.3
8.	Orissa	6,226.8	265.2	978.8	365.6	NA	1,609.6	4.3	16.5
9.	Madhya Pradesh	19,141.6	163.6	1,204.0	1,179.4	222.2	2,769.2	0.9	5.9
10.	Bihar	7,662.6	109.0	1,014.2	985.0	580.2	2,688.4	1.4	4.1
11.	Kerala	2181	47.4	103.6	34.3	95.0	280.3	2.2	16.9
12.	Gujarat	9621	40.8	463.8	1,733.0	4.4	2,242.0	0.4	1.8
13.	Pondicherry	29	1.4	10.6	13.2	0.2	25.4	4.8	5.5
14.	Jammu and Kashmir	727.2	3.2	294.4	3.8	12.4	313.8	0.4	1.0
15.	Tripura	253	1.6	27.8	6.0	5.0	40.4	0.6	4.0
	All India	142,953.4	3,392.4	16,277.5	19,511.1	2,376.0	41,557.0	2.4	8.2

Note: NA = Not available; * NIA by tanks for Maharashtra is not available in the Indian Agricultural Statistics volume, hence the M I Census data have been used. All India total includes the data on all States and Union Territories.

Source: GOI, Indian Agricultural Statistics, 1981-82 — 1985-86, Vol. I, New Delhi, 1989.

irrigation in the three southern states (Andhra Pradesh, Karnataka and Tamil Nadu). This description, based largely on secondary data and a few independent studies, shows how inadequate and patchy our knowledge is. The findings of a detailed first-hand study of physical conditions, management and functioning of some 80 selected tanks in two river basins of Tamil Nadu (namely the Periyar Vaigai and the Palar) are presented in Chapter 3 and 4. Chapter 5 provides a detailed account of the structure, functioning and impact of irrigation institutions under two large multi-village tanks in Tamil Nadu. In the light of the findings, the concluding chapter discusses needed modifications in policies and programmes for tank irrigation in the interests of both increasing productivity and ensuring sustainable use of soil and water resources.

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Chapter 2

TANK IRRIGATION IN SOUTH INDIA: AN OVERVIEW

A Vaidyanathan
K Sivasubramaniyan

HISTORICAL BACKGROUND

Most tanks in south India are of ancient origin, with several dating back to the 4th and 5th centuries AD. From the few studies of the history of tank irrigation in this part of the country (Ludden 1978; Narasimha Reddy et al 1990; Dikshit et al 1994), it is apparent that prior to the advent of colonial rule, tanks were constructed by local landlords, local chieftains, and sometimes, urban traders. They were maintained and managed by local communities. In Tamil Nadu, for instance, under the *mirasi* system of land tenure, maintenance of tanks was one of the community activities for which a part of the produce of the village was earmarked. There were well-defined rules regarding repairs and water allocation and *mirasidars* had the authority to ensure that these were enforced. Often there were functionaries specifically assigned the task of handling tank-related matters. In Karnataka, the village community entrusted the responsibility to a person or group of persons who were granted a certain amount of land or tax benefit for carrying out the function. (Dikshit, et al, 1994: 157-88). Similar arrangements evidently existed in the Andhra region as well (Narasimha Reddy, et al, 1990).

Wars, which led to the British acquiring control over this region, saw considerable damage to tanks. Significant changes in the land-tenure systems and the socio-political structure of village society took place with the advent of colonial rule. For instance, in the old Madras Presidency, the replacement of *mirasi* system by the *ryotwari* system weakened the earlier socio-economic structures which took care of community activity. In some areas the recognition of local chieftains/rulers as *zamindars* with title over land and tanks seems to have had the same effect.

The poor and deteriorating state of tanks was a matter of concern for the colonial government mainly because they were an important source of irrigation and contributed substantially to land revenue. This led the government in the old Madras Presidency to introduce legislation to enforce community contributions for maintenance and repair. When this failed, government assumed direct responsibility for these functions and repair. Government also took up investments for restoring and improving irrigation works wherever they were likely to augment revenues substantially (Sarada Raju 1941, Ramanathan).

The late 19th and early 20th centuries witnessed efforts to improve tank irrigation partly by undertaking repairs to existing tanks which were in a poor condition, partly by construction of new tanks and partly by construction/remodelling of *anicuts* across rivers to augment the supplies to the existing system tanks and increase the number of system tanks. In Tamil Nadu such works were undertaken in Palar, Vaigai and Tambraparani basins. It is important to note that these investments were taken up only when government was satisfied about earning a minimum rate of financial return in the form of additional land revenue.

Following the recommendations of the Famine Commission of 1878-80, the government of the then Madras Presidency initiated a tank restoration scheme (TRS) in 1883 with a view to surveying the tanks, laying down the standards for *bunds*, sluices, surplus-weirs and other structures to which each tank should conform and for taking steps to see that the tanks were brought up to the specified standards. The TRS has had a chequered record: this scheme, ushered in with so much hope and enthusiasm, has never been pursued with tenacity. In the last century it repeatedly suffered from financial stringency and retrenchment. Thus, in 1906 four Special Tank Restoration divisions were sanctioned, and in 1912 one more division was added; but in 1916 two divisions were abolished and, though in 1918 these two divisions were revived, in 1922 all divisions

were abolished. In 1928 three divisions were revived, but in 1931 all the divisions were again abolished and it was not till 1941-43 that a couple of divisions were again sanctioned to do something towards the completion of work which had been dragging on for more than half a century (Baliga 1960:200; cited in MIDS 1986. See also Narasimha Reddy et al, 1988).

By the time of Independence most PWD tanks in the old Madras Presidency (except those under the control of *zamindars*) were reported to have been surveyed under TRS. The technical details of the tanks covered by the survey have been published in a series called *Tank Memoirs*. These *memoirs* — though printed — are not easily accessible at one place: the few copies which can be located are often in an unusable condition. There has been no systematic collation or analysis of the *Memoirs* data, nor any mechanism to follow up or update the information in the light of changing conditions of water supply and use patterns in the tanks. Nor do we have details of the programme taken up during this period to bring them to certain minimum specifications. It is not known exactly how many tanks had been covered by TRS, how many of these were brought up to the specified standards and when.

Mysore, then a princely state, also witnessed a similar trend in the late 19th century: A substantial effort at minor tank restoration was made which, by the turn of the century, covered 2,831 major and minor tanks. The scheme continued in the early decades of the 20th century, with government contributing two-thirds of the cost on the condition that the farmers would meet the rest. The progress was slower than expected reportedly due to the lack of enthusiasm on the part of villagers to share the cost and the inability or unwillingness of the government to take up the task on its own. Nevertheless, some progress was made and by 1946-47 most of the major tanks were reported to have been restored. Most minor tanks remained in disuse. This period also witnessed a sizable programme for construction of new tanks in the region (Dikshit et al)[1].

POST-INDEPENDENCE DEVELOPMENTS

As in the rest of the country, the post-Independence period witnessed a massive effort at irrigation development in the three southern states, though largely centred on largescale reservoir-cum-canal projects. *(Table 2.1)* During the four decades ending 1997, AP spent Rs 72 billion, Karnataka Rs 51 billion and Tamil Nadu Rs 19 billion under the public sector plan on all forms of irrigation. About 30–32 per cent of the total outlay in AP and Karnataka was spent on minor irrigation. The relatively low outlay in irrigation and the exceptionally high proportion (65 per cent) devoted to minor irrigation in Tamil Nadu reflects the fact that the potential for large scale canal irrigation had been more or less fully exploited.

Table 2.1: Outlays for Irrigation Development in the 3 Southern States of India, 1956-97

(Rs crores)

State	1956-1966		1966-1978		1978-1990		1990-1997		Total	
	Outlay	%	Outlay	%	Outlay	%	Outlay	%	Outlay	%
Andhra Pradesh										
All irrigation & flood control	193.0	100.0	647.8	100.0	3,124.5	100.0	3,254.3	100.0	7,220	100.0
Minor Irrigation										
Direct	36.3	18.8	59.1	9.1	252.5	8.1	400.0	12.3	748	10.4
Institutional	7.7	4.0	140.0	21.6	612.0	19.6	650.0	20.0	1,410	19.5
Karnataka										
All irrigation & flood control	111.3	100.0	564.4	100.0	1,678.4	100.0	2,739.8	100.0	5,094	100.0
Minor Irrigation										
Direct	47.3	42.5	104.3	18.5	280.8	16.7	450.0	16.4	882	17.3
Institutional	5.7	5.1	105.3	18.7	318.3	19.0	310.0	11.3	739	14.5
Tamil Nadu										
All irrigation & flood control	82.5	100.0	346.7	100.0	693.0	100.0	844.0	100.0	1,896	100.0
Minor Irrigation										
Direct	29.3	35.5	92.3	26.6	171.3	24.7	450.0	58.1	743	39.2
Institutional	7.1	8.6	160.2	46.2	134.2	19.4	200.0	25.8	502	26.4

Note: Percentage figures refer to the total outlay.

Sources: GOI., Ministry of Water Resources, Report of the Working Group on Minor Irrigation (pp. 112-3, 149 and 151) and Major & Medium Irrigation (pp. A-11, A-12) Formulation of the Eighth Plan (1990-95) Proposals Constituted by the Planning Commission, New Delhi, 1989.
GOI, Planning Commission, Eighth FYP, 1992-97, Vol. II, New Delhi, pp. 73-91. 1992.
GOI, Economic Survey, 1995-96, Ministry of Finance, Economic Division, New Delhi, pp. S-45 and S-46.

In all three states, the main thrust of minor irrigation was groundwater development, rather than small surface works. In Tamil Nadu, for which data regarding plan outlays on minor surface works is available for recent years, a total of Rs 3.5 billion was spent on these works between 1980 and 1997, which constitute barely 25 per cent of the direct state outlays and a sixth of the total outlays (including institutional finance), on all minor irrigation. The pattern is unlikely to be very different in the other two states. Before discussing the performance of these programmes, it is appropriate to review the salient features of tank irrigation in the region.

CHARACTERISTICS OF TANK IRRIGATION IN SOUTH INDIA

As already noted, nearly 60 per cent of area under tank irrigation in the country is accounted for by Andhra Pradesh, Karnataka and Tamil Nadu. Together, they have nearly 120,000 tanks (out of the 208,000 in the country as a whole) irrigating 1.8 million hectares. In 1989-90, the area irrigated by tanks in these three states taken together comprised a little over a fifth of the total irrigated area and 6.7 per cent of the total cultivated area. By both indicators tanks are more prominent in Andhra Pradesh and Tamil Nadu than in Karnataka.

REGIONAL DISTRIBUTION

The distribution of tank irrigation, as well as its importance as a source of irrigation within the region, is highly variable. Nearly 70 per cent of the total *ayacuts* of tanks in the three states is concentrated in 19 districts (out of 60 districts); two-fifths is accounted for eight districts. The proportion of net irrigated area served by tanks varies from less than 10 per cent in 22 districts and to over 40 per cent in 16 districts. In three districts of Tamil Nadu (Pudukkottai, Pasumpon Muthuramalingam and Ramanathapuram) tanks are the dominant irrigation source accounting for over 80 per cent of total irrigated area. Similarly, as a proportion of total cultivated area, the area under tanks is as little as one per cent and as high as 50 per cent. In eight districts of Andhra Pradesh and Tamil Nadu over a fifth of the sown area depends on tank irrigation *(Tables 2.2, 2.3* and *2.4)*.

There is a distinct pattern in the spatial distribution of tank irrigation according to all these indices. The districts where tank irrigation is concentrated lie mostly in the coastal areas of Tamil Nadu, south and north coastal Andhra, and parts of Telengana *(Map 2.1)*. These are also among the districts where tanks serve a relatively high proportion of both total irrigated and total sown areas *(Maps 2.2* and *2.3)*. Others in this category include an east-west belt stretching from North Arcot in Tamil Nadu to Shimoga in Karnataka.

In Tamil Nadu, tanks are dominant as a source of irrigation, accounting for over 40 per cent of irrigated area in eight out of the 19 districts; they account for 15-25 per cent of average net irrigated area in six other districts. Tanks are insignificant as an irrigation source in Tiruchi, Thanjavur, Salem, Periyar and Coimbatore districts. A more disaggregated picture of spatial variations using taluk level data *(see Map 2.4)* shows that tank irrigation is more prominent than the state average (in terms of both the percentage of net sown area irrigated by tanks and percentage of net irrigated area under tanks) in the Palar, the Pennar, the Vaigai and the Tambraparani basins. There is comparatively little tank irrigation in the Cauvery basin.

The spatial distribution of tank irrigation seems to reflect variations in topography and rainfall patterns. Topographic features along the coastal plains, the Mysore plateau and Telengana are conducive to impounding of stream flow in small, shallow storages. Regions which have a bimodal seasonal distribution of rainfall — with significant precipitation in both monsoons — are also more likely to have tanks.

SIZE DISTRIBUTION

Being small storages, tanks have relatively small *ayacuts*. The *ayacut* per tank averages 22 hectares in the three states taken together. It being the lowest (17 hectares) in Karnataka and the highest (26 hectares) in Tamil Nadu. About 86 per cent of tanks in these three states irrigate less than 40 hectares each and 13 per cent have *ayacuts* in the range of 40 to 200 hectares. Nearly 92 per cent of the Karnataka tanks serve less than 40 hectares each, while in Tamil Nadu the corresponding figure is only 77 per cent. In Tamil Nadu over a fifth of the tanks are in the medium size group (40-200 hectares) compared to a mere 7 per cent in Karnataka. While `large tanks' (>200 hectares) constitute barely one per cent of all tanks in terms of numbers, they account for about 22 per cent of the total *ayacuts* of tanks, the proportion ranging from 18 per cent in Karnataka to 25 per cent in Tamil Nadu *(Table 2.5)*.

In Tamil Nadu, where somewhat more detailed information on size distribution of tanks is available, nearly two-fifths have *ayacuts* of less than 20 hectares; more than half serve less than 40 hectares. There are only 534 tanks (less than 2 per cent of the total number) with *ayacuts* exceeding 200 hectares; but these tanks are

Table 2.2: Districtwise Data on Net Sown, Net Irrigated and Tank Irrigated Area in Andhra Pradesh, 1985-86 — 1987-88

(area in hectares)

Sl No	Districts	1985-86 to 1987-88			5*100/TTIA in 3 States	Col.5/Col.4* 100	Col.5/Col.3* 100
		NSA	All NIA Sources	Tanks			
1	2	3	4	5	6	7	8
1.	Srikakulam	2,82,231	1,51,639	67,674	4.25	44.63	23.98
2.	Vizianagaram	2,87,314	1,02,462	69,421	4.36	67.75	24.16
3.	Visakhapatnam	2,66,433	94,655	32,770	2.06	34.62	12.30
4.	East Godavari	4,05,797	2,56,752	28,665	1.80	11.16	7.06
5.	West Godavari	4,12,337	3,42,520	33,461	2.10	9.77	8.11
6.	Krishna	4,75,173	3,40,674	27,251	1.71	8.00	5.73
7.	Guntur	5,92,687	3,22,947	2,586	0.16	0.80	0.44
8.	Prakasam	5,70,417	1,51,792	29,713	1.87	19.58	5.21
9.	Nellore	3,20,169	2,47,448	94,506	5.94	38.19	29.52
	Costal Andhra Region	36,12,559	20,10,889	3,86,047	24.25	19.20	10.69
10.	Kurnool	8,71,208	1,10,538	11,222	0.70	10.15	1.29
11.	Anantapur	8,19,061	1,17,285	8,396	0.53	7.16	1.03
12.	Cuddapah	3,72,875	96,286	8,251	0.52	8.57	2.21
13.	Chittoor	4,29,432	1,22,087	38,611	2.43	31.63	8.99
	Rayalaseema Region	24,92,576	4,46,196	66,479	4.18	14.90	2.67
	Andhra Region	61,05,136	24,57,085	4,52,526	28.42	18.42	7.41
14.	Rangareddy	2,95,804	39,997	4,970	0.31	12.43	1.68
15.	Hyderabad	490	416	18	0.00	4.40	3.74
16.	Nizamabad	2,74,834	1,31,918	27,655	1.74	20.96	10.06
17.	Medak	4,12,036	95,350	37,998	2.39	39.85	9.22
18.	Mahbubnagar	7,53,658	80,719	8,670	0.54	10.74	1.15
19.	Nalgonda	5,94,601	1,52,270	16,956	1.07	11.14	2.85
20.	Warangal	4,42,937	1,71,902	80,109	5.03	46.60	18.09
21.	Khammam	4,21,976	1,38,021	52,163	3.28	37.79	12.36
22.	Karimnagar	4,14,044	1,72,122	43,238	2.72	25.12	10.44
23.	Adilabad	6,00,407	46,018	17,591	1.10	38.23	2.93
	Telangana Region	42,10,787	10,28,732	2,89,368	18.18	28.13	6.87
	State Total	**1,03,15,923**	**34,85,817**	**7,41,894**	**46.60**	**21.28**	**7.19**

Note: TTIA = Total tanks irrigated area; NSA = Net Sown Area; NIA = Net Irrigated Area.
Source: GOAP, Season and Crop Reports, Various Issues, Hyderabad.

estimated to irrigate 2,56,000 hectares or nearly 25 per cent of the total area *(Table 2.6)*. There are a few "large" tanks with *ayacuts* exceeding 1,000 hectares, the largest of them serving 6,000 hectares.

Districtwise data *(Table 2.7)* on the distribution of tanks and *ayacuts* (in terms of NIA by tanks — 3 years, average) show that in Andhra Pradesh the average *ayacut* per tank ranges from as low as 1 hectare in Rangareddy district in Telengana region, to as much as 58 hectares in Nellore district in the coastal Andhra region. The corresponding figures for Karnataka are 9 hectares in North Kanara and 163 hectares in Bijapur *(Table 2.8)*. In Tamil Nadu the comparable figures lie in the range of 7 hectares to 67 hectares. Tanks in the coastal

Table 2.3: Districtwise Data on Net Sown, Net Irrigated and Tank Irrigated Area in Karnataka, 1985-86 — 1987-88

(area in hectares)

Sl No	Districts	1985-86 to 1987-88			5*100/TTIA in 3 States	Col.5/Col.4* 100	Col.5/Col.3* 100
		NSA	All NIA Sources	Tanks			
1	2	3	4	5	6	7	8
1.	South Kanara	2,97,921	85,740	3,402	0.21	3.97	1.14
2.	North Kanara	1,10,136	21,250	9,825	0.62	46.24	8.92
	Coastal Region	4,08,058	1,06,990	13,228	0.83	12.36	3.24
3.	Chikmagalur	3,09,837	27,236	12,804	0.80	47.01	4.13
4.	Hassan	3,77,547	47,286	20,883	1.31	44.16	5.53
5.	Kodagu	1,45,940	4,583	860	0.05	18.76	0.59
6.	Shimoga	3,18,333	1,41,353	56,748	3.56	40.15	17.83
	Eastern Region	11,51,658	2,20,458	91,295	5.73	41.41	7.93
7.	Belgaum	9,14,920	2,15,012	4,876	0.31	2.27	0.53
8.	Bellary	5,74,734	1,46,398	3,954	0.25	2.70	0.69
9.	Bidar	3,56,977	28,132	750	0.05	2.67	0.21
10.	Bijapur	13,39,550	1,81,872	6,429	0.40	3.54	0.48
11.	Chitradurga	5,58,845	1,21,410	9,291	0.58	7.65	1.66
12.	Dharwar	10,36,576	97,980	12,583	0.79	12.84	1.21
13.	Gulbarga	12,24,980	59,442	4,760	0.30	8.01	0.39
14.	Raichur	10,15,872	1,75,740	2,433	0.15	1.38	0.24
	Northern Region	70,22,454	10,25,985	45,076	2.83	4.39	0.64
15.	Bangalore	3,89,085	64,837	25,781	1.62	39.76	6.63
16.	Kolar	3,54,367	81,676	21,713	1.36	26.58	6.13
17.	Mandya	2,55,772	98,374	8,637	0.54	8.78	3.38
18.	Mysore	5,04,480	1,11,496	9,315	0.59	8.35	1.85
19.	Tumkur	5,32,092	71,812	38,030	2.39	52.96	7.15
	Southern Region	20,35,796	4,28,194	1,03,476	6.50	24.17	5.08
	State Total	**1,06,17,965**	**17,81,627**	**2,53,074**	**15.90**	**14.20**	**2.38**

Note: TTIA = Total tank irrigated area; NSA = Net Sown Area; NIA = Net Irrigated Area.
Source: GOI, Indian Agricultural Statistics, Department of Agriculture and Cooperation, Vol. II, 1985-86 to 1987-88, New Delhi, 1992.

and hilly tracts of Karnataka tend to be relatively small (15 hectares on the average); the average size of tanks seems to be larger (> 30 hectares) along the northern Tamil Nadu coastal districts, the Tambraparani basin, and in northern Karnataka *(Map 2.5)*.

These data should however be interpreted with much caution: The PWD has no systematic arrangements for maintaining an up-to-date inventory of tanks and their *ayacuts*. Available compilations tend to be outdated. Moreover, the number of tanks as reported in the Season and Crop reports vary over time; and the net area irrigated by them vary and in general are much below the PWD figures of registered *ayacut (Table 2.9)*. Thus in the case of Andhra Pradesh, the net area irrigated by tanks does not exceed 1.34 million hectares in any year. The PWD figure for total *ayacuts* of tanks is 1.85 million hectares while the actual net area irrigated reported in the Season and Crop Reports during the 1980s averaged only 9 lakh hectares. Much the same is true of Tamil Nadu and Karnataka. The difference between the two sets of figures is particularly marked in Karnataka, the PWD figure being about twice that reported in the Season and Crop report during the 1980s[2].

Apart from this, tanks are classified according to

Table 2.4: Districtwise Data on Net Sown, Net Irrigated and Tank Irrigated Area in Tamil Nadu, 1985-86 — 1987-88

(Area in hectares)

Sl No	Districts	1985–86 to 1987–88			5*100/TTIA in 3 states	Col.5/Col.4* 100	Col.5/Col.3* 100
		NSA	All NIA sources	Tanks			
1	2	3	4	5	6	7	8
1.	Chengalpattu	2,77,974	2,15,965	1,00,699	6.33	46.63	36.23
2.	South Arcot	5,81,870	3,07,441	72,802	4.57	23.68	12.51
3.	North Arcot	4,60,263	2,11,373	44,737	2.81	21.16	9.72
4.	Salem	3,98,916	1,02,900	3,534	0.22	3.43	0.89
5.	Dharmapuri	4,08,786	82,346	15,408	0.97	18.71	3.77
6.	Coimbatore	3,56,082	1,34,441	2,100	0.13	1.56	0.59
7.	Periyar	3,21,453	1,14,005	332	0.02	0.29	0.10
8.	Tiruchirapalli	5,43,253	1,48,296	12,768	0.80	8.61	2.35
9.	Pudukkottai	1,95,787	1,03,257	80,754	5.07	78.21	41.25
10.	Thanjavur	5,11,283	4,40,553	1,953	0.12	0.44	0.38
11.	Madurai	2,90,371	1,34,793	25,292	1.59	18.76	8.71
12.	Dindigul-Anna	2,62,581	74,648	11,400	0.72	15.27	4.34
13.	Ramanathapuram	2,10,874	63,214	57,123	3.59	90.36	27.09
14.	Kamarajar	1,97,415	58,439	27,554	1.73	47.15	13.96
15.	P.Muthuramalingam	1,30,088	77,026	65,554	4.12	85.11	50.39
16.	Tirunelveli Kattabomman	2,23,702	1,11,311	49,231	3.09	44.23	22.01
17.	Chidambaranar	1,53,015	23,944	11,274	0.71	47.08	7.37
18.	The Nilgiris	66,868	519	41	0.00	7.90	0.06
19.	Kannyakumari	80,393	26,900	14,534	0.91	54.03	18.08
	State Total	**56,70,975**	**24,31,370**	**5,97,088**	**37.50**	**24.56**	**10.53**

Note: TTIA = Total tank irrigated area; NSA = Net Sown Area; NIA = Net Irrigated Area.
Source: GOTN, Season and Crop Report, Various Issues, Tamil Nadu.

Table 2.5: Size Distribution of Tanks in the Three Southern States of India

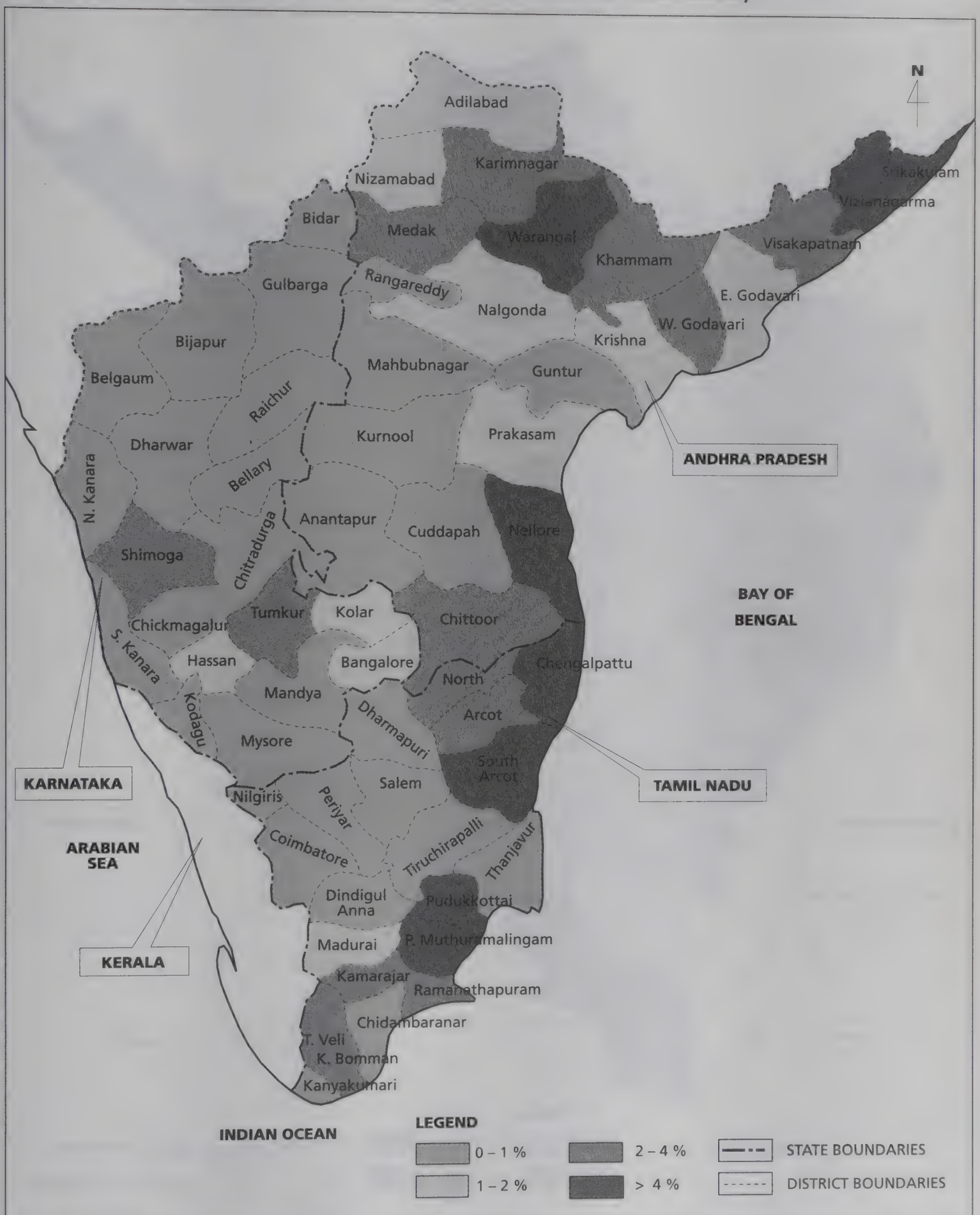
(*Ayacut* in '000 hectares)

Size Class (Hectares)	Andhra Pradesh[1]				Karnataka[2]				Tamil Nadu[3]				Total			
	No	%	*Ayacut*	%	No	%	*Ayacut*	%	No	%	*Ayacut*	%	No	%	*Ayacut*	%
< 40	70,474	86.3	610	32.9	35,235	92.4	266	42.2	30,263	77.2	261	25.8	1,35,972	85.5	1,137	32.5
40–200	10,252	12.6	833	44.9	2,605	6.8	253	40.1	8,405	21.4	495	48.9	21,262	13.4	1,581	45.2
> 200	961	1.2	411	22.2	288	0.8	112	17.7	534	1.4	256	25.3	1,783	1.1	779	22.3
Total	81,687	100.0	1,854	100.0	38,128	100.0	631	100.0	39,202	100.0	1012	100.0	1,59,017	100.0	3,497	100.0

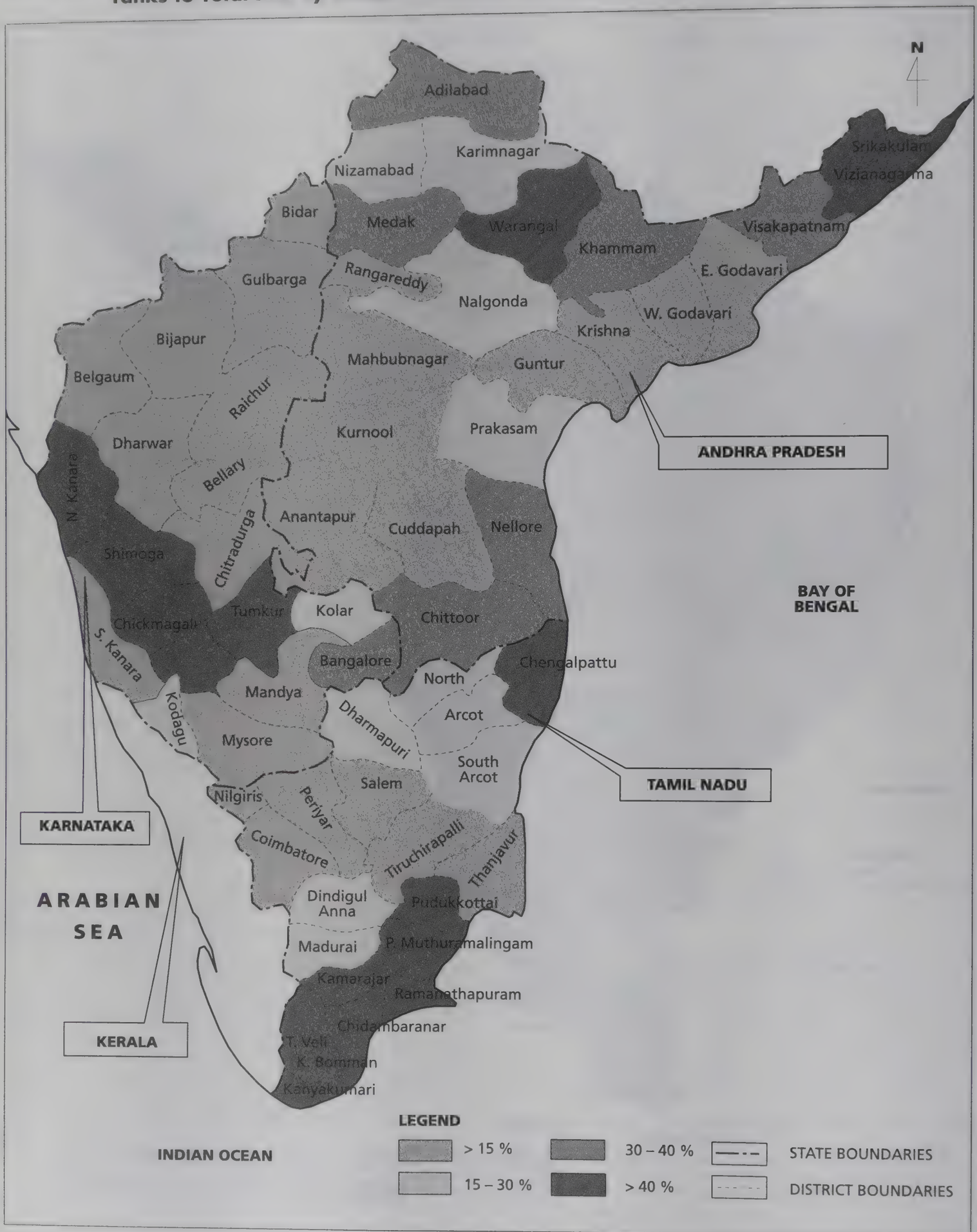
Note: (1) The Andhra Pradesh data are very much at variance with data given in the Season and Crop Reports cited and used in the rest of this chapter. (2) In Tamil Nadu the total No of tanks under < 40 hectares and *ayacut* served by them includes all ex-Zamin tanks. In the latter category no separate size distribution of tanks is available, but given that the average *ayacut* per tank in this category is less than 10 ha, most of them are likely to fall in the < 40 hectare group.

Source: 1.Koteswara Rao (1992) Relates to 1992. 2.Nadkarni, et al, (1979) Relates to 1974. 3.GOTN, PWD (1977) Relates to 1977.

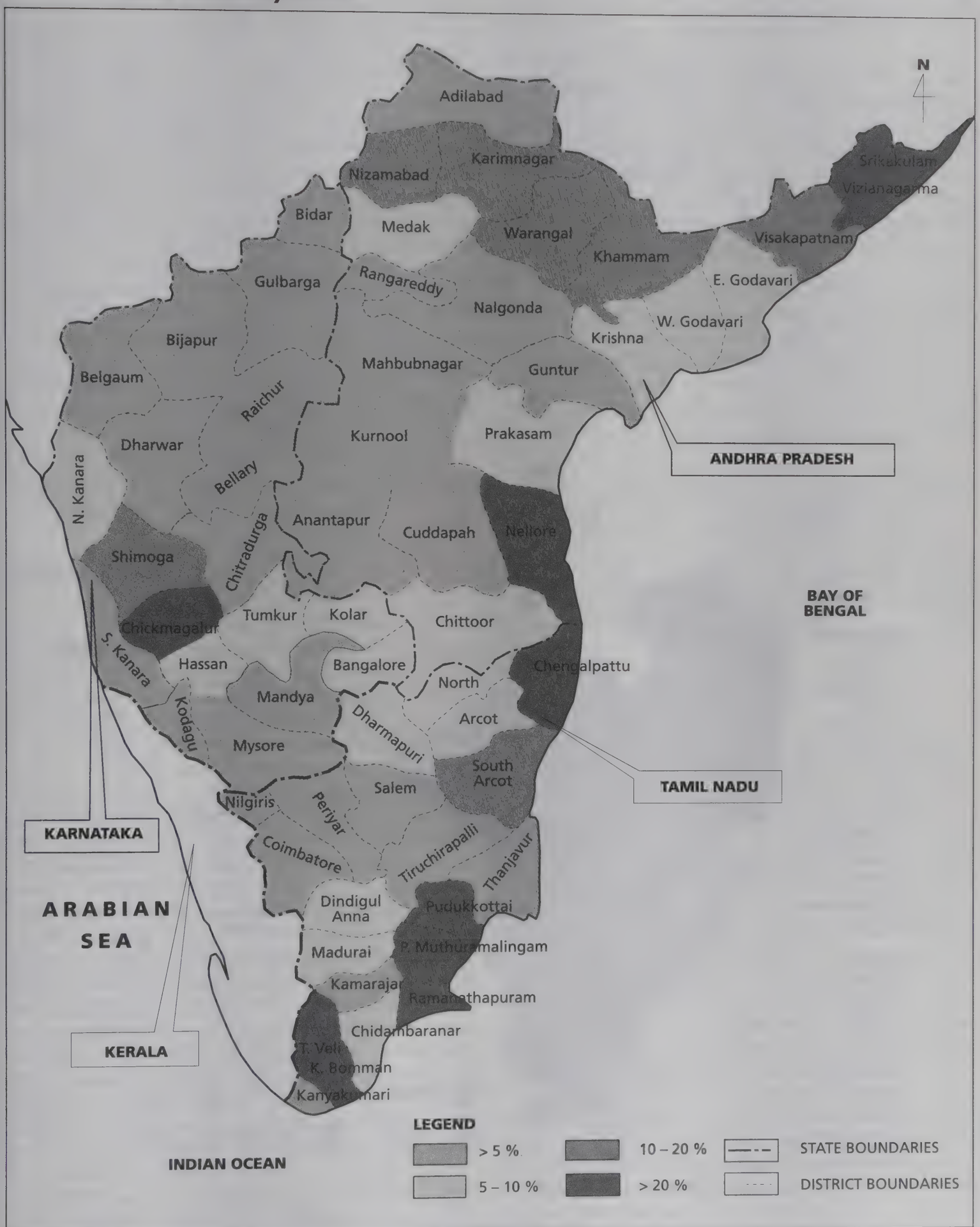
Map 2.1: Spatial Distribution of Tank Irrigation in the Three Southern States of India (Net Irrigated Area by Tanks to Total Tank Irrigated Area in the Three States)



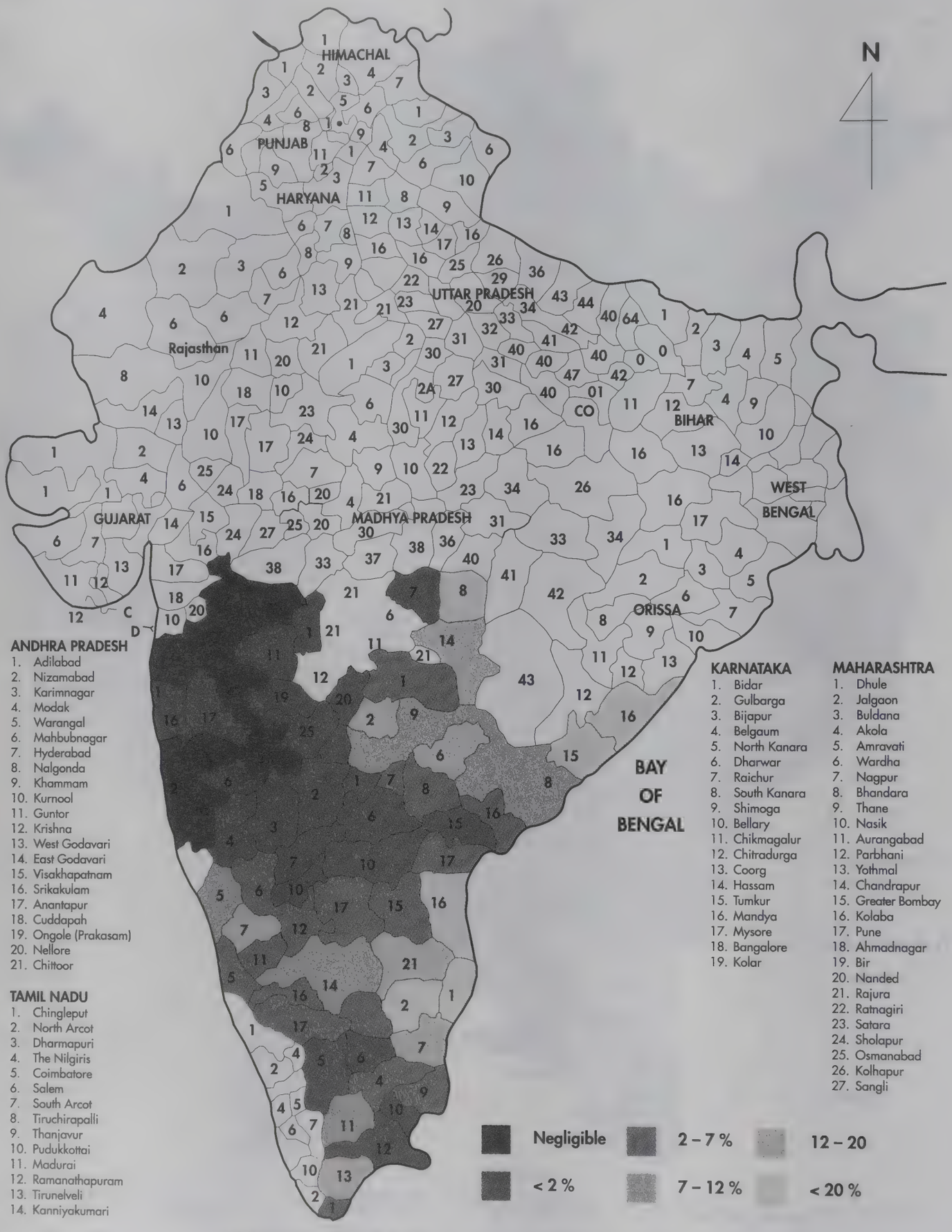
Map 2.2: Spatial Distribution of Tank Irrigation in the Three Southern States of India NIA by Tanks to Total NIA by States



Map 2.3: Spatial Distribution of Tank Irrigation in the Three Southern States of India NIA by Tanks to NSA by States



Map 2.4: Density of Tanks (% Tank Irrigated Area to Net Sown Area)



ANDHRA PRADESH
1. Adilabad
2. Nizamabad
3. Karimnagar
4. Modak
5. Warangal
6. Mahbubnagar
7. Hyderabad
8. Nalgonda
9. Khammam
10. Kurnool
11. Guntor
12. Krishna
13. West Godavari
14. East Godavari
15. Visakhapatnam
16. Srikakulam
17. Anantapur
18. Cuddapah
19. Ongole (Prakasam)
20. Nellore
21. Chittoor

TAMIL NADU
1. Chingleput
2. North Arcot
3. Dharmapuri
4. The Nilgiris
5. Coimbatore
6. Salem
7. South Arcot
8. Tiruchirapalli
9. Thanjavur
10. Pudukkottai
11. Madurai
12. Ramanathapuram
13. Tirunelveli
14. Kanniyakumari

KARNATAKA
1. Bidar
2. Gulbarga
3. Bijapur
4. Belgaum
5. North Kanara
6. Dharwar
7. Raichur
8. South Kanara
9. Shimoga
10. Bellary
11. Chikmagalur
12. Chitradurga
13. Coorg
14. Hassam
15. Tumkur
16. Mandya
17. Mysore
18. Bangalore
19. Kolar

MAHARASHTRA
1. Dhule
2. Jalgaon
3. Buldana
4. Akola
5. Amravati
6. Wardha
7. Nagpur
8. Bhandara
9. Thane
10. Nasik
11. Aurangabad
12. Parbhani
13. Yothmal
14. Chandrapur
15. Greater Bombay
16. Kolaba
17. Pune
18. Ahmadnagar
19. Bir
20. Nanded
21. Rajura
22. Ratnagiri
23. Satara
24. Sholapur
25. Osmanabad
26. Kolhapur
27. Sangli

the location of responsibility for their maintenance; whether they receive supply from rainfall in their catchment alone or tap sources from a wider catchment; and by the duration for which they can supply water for irrigation. In general, *panchayat* unions are responsible for management of tanks with *ayacut* of less than 40 hectares. However, Tamil Nadu has some 10,000 tanks which were under the control of *zamindars*. With the abolition of *zamindari* tenure, these have vested with the government but their status (in terms of the location of responsibility for maintenance and management) remains undecided. They are even now reported as a separate category. Tanks with an *ayacut* of more than 40 hectares are under PWD (or the Irrigation Department in Andhra Pradesh) which is responsible for maintenance and repairs of inlet channels and physical structures of the tank. Arrangements for water management within the *ayacut* however vary: This task is left to the irrigation communities in Tamil Nadu while the PWD and/or revenue officials are reported to be formally responsible for these tasks in Andhra Pradesh and Karnataka. Little information is available on precisely what their responsibilities are or on how they are actually managed on the ground.

SOURCES OF SUPPLY

In terms of the characteristics of source of water supply, tanks fall into three categories: (1) Those which depend on rainfall in immediate catchment and are not linked to tanks upstream or downstream of the stream draining the catchment. These are "isolated" rainfed tanks; (2) Those which form part of a chain of tanks drawing supplies from the stream draining the watershed, with the surplus of upstream tank feeding tanks downstream; and, (3) Tanks fed by diversion weirs or reservoirs across rivers with relatively large catchments (Uma Sankari and Esha Shah, 1993). Other things being given, the larger the catchment from which a tank is fed, the more abundant and assured is likely to be its water supply. Therefore, during the British rule, the old Madras Presidency distinguished between "system" and "non-system" tanks, the former corresponding to category (3) and the latter including categories (1) and (2). This classification is, however, confined to tanks which are under the control of the PWD, which includes all rainfed tanks with an *ayacut* more than 40 hectares and all system tanks. This practice continues to be followed in Tamil Nadu and parts of Andhra Pradesh which belonged to the old Madras Presidency[3], but not in Karnataka.

About 10 per cent of all the tanks, and about 40 per cent of PWD tanks in Tamil Nadu are system tanks. They serve an *ayacut* of about 2,16,000 hectares *(Table 2.10)*. There are relatively few system tanks with *ayacuts* less than 40 hectares. Of the 8,939 PWD tanks in Tamil Nadu, which mostly have *ayacuts* exceeding 40 hectares, 3,697 are system tanks. Among the 534 tanks with *ayacuts* exceeding 200 hectares, 161 are system tanks with an average *ayacut* of 700 hectares each compared to an average of 250 hectares for non-system tanks in this size class (GOTN, 1979:21). On the average, system tanks in Tamil Nadu are smaller (in terms of registered *ayacut* served) than non-system PWD tanks. But this is not the case everywhere. In some districts (for example Chengai-MGR, South Arcot, Dharmapuri and Trichirapalli) the average *ayacut* of system tanks is larger than that of non-system tanks.

System tanks are more prominent (in terms of their numbers and *ayacut* as a proportion of all PWD tanks) in some districts than others. Most tanks in Thanjavur are system tanks, there being hardly any in Salem, Dharmapuri, Coimbatore and Periyar districts. The system tanks are found to be concentrated in the Cauvery, the Palar, the Vaigai and the Tambraparani basins *(Table 2.11)*.

In Andhra Pradesh only 1,017 tanks (out of a total of 9,348 PWD tanks) fall in this category *(Table 2.12)*. Most (86 per cent) of system tanks are in the coastal Andhra region. About a third of the tanks in this region belong to this category. System tanks are rare in Telengana and Rayalaseema, both in absolute terms and as a proportion of the total PWD tanks.

CAPACITY AND DURATION OF SUPPLY

Tanks vary not only in size and source of supply, but also in terms of water storage relative to command, the duration of supplies, and its reliability. We have some scattered evidence of these aspects in particular areas. For instance, analysis of data for 45 tanks in Andhra Pradesh (Von Oppen and Subba Rao 1980a) shows that the average storage capacity for a small tank (commanding less than 40 hectares) is less than 12 mcft; and for large tanks (commanding more than 400 hectares) is around 410 mcft. The average depth of storage is barely 4-5 feet: larger tanks tend to be deeper than smaller ones. In a sample of 20 tanks under EEC modernisation programme in Tamil Nadu, the depth ranged from less than 1 metre to a maximum of 1.6 metres (Anna University, Centre for Water Resources, 1989).

Tanks being shallow storages, the area under submergence in relation to the area irrigated tends to be relatively high. A study of 245 Tamil Nadu tanks (GOI, PC, 1959) estimated that on the average area submerged by storage is about 0.77 hectares for one hectare of *ayacut*. The ratio ranged from 0.8 to 1.3 for a sample

Table 2.6: Districtwise Size-distribution of Tanks in Tamil Nadu, 1977

Sl No	District	Panchayat union tanks							
		<20 ha		20-40 ha		Total		40-200 ha	
		No	*Ayacut*	No	*Ayacut*	No	*Ayacut*	No	*Ayacu*
1	Chengai-MGR	1,241	4,858	542	13,158	1,783	18,016	1088	95,07
2	North Arcot Ambedkar + T.V.Malai Sambuvarayar	1,482	5,668	602	14,615	2,084	20,283	1116	74,45
3	South Arcot	1,213	4,858	553	13441	1,766	18,300	692	43,57
4	Salem	449	1,619	100	2,429	549	4,049	181	14,85
5	Dharmapuri	1,451	5,668	128	3,117	1,579	8,785	95	6,970
6	Coimbatore + Periyar	42	162	22	526	64	688	52	5,252
7	Thanjavur	338	1,215	153	3,725	491	4,939	663	22,53
8	Tiruchirapalli	4,609	18,462	725	17,611	5,334	36,073	238	16,05
9	Pudukkottai							508	32,30
10	Madurai + Anna	3,142	12,551	249	6,032	3,391	18,583	731	41,85
11	Ramanathapuram + PMT + Kamarajar	642	2,429	691	1,6761	1,333	19,190	1,419	97,360
12	T.Veli Kattabomman + Chidambaranar	806	3,239	159	3,846	965	7,085	642	35,430
13	Kanyakumari	1,062	4,049	12	283	1,074	4,332	980	9,435
14	Nilgiris	0	0	0	0	0	0	0	0
	Total	**16,477**	**64,777**	**3,936**	**95,547**	**20,413**	**1,60,324**	**8,405**	**4,95,14**

Note: PMT = Pasumpon Muthuramalinga Thevar district.
Source: GOTN, Chief Engineer for Minor Irrigation, PWD, Madras, 1977.

of 45 Andhra Pradesh tanks. The loss of land due to submergence is thus relatively high in tanks; and their shallow depth also means that the evaporation losses in storage are relatively higher than in large reservoirs which tend to be deeper. Von Oppen and Subba Rao found the ratio of submergence to *ayacut* to be inversely related to the size of *ayacut (Table 2.13)*.

The storage capacity per hectare of *ayacut* varies. The average for selected tanks in Andhra Pradesh ranged from 1,71,000 cubic feet (cu.ft) or 4,843 cubic metres (cu.m) to 2,17,000 cu.ft (6,146 cu.m.) per acre, with this figure being positively correlated to the size of the tanks (Von Oppen and Subba Rao 1980a). In the PAS command, the overall average for system tanks is around 1,50,000 cu.ft (4,248 cu.m) per acre. Here again, the tanks with smaller *ayacuts* tend to have a smaller capacity per unit of *ayacut* compared to those with larger *ayacut* (Vaidyanathan and Janakarajan 1989:16).

Tanks also differ in the period for which they can be depended upon to supply water. Tamil Nadu has a system of classifying tanks according to number of crop seasons for which they can supply water for irrigating crops in a normal year[4]. But these data (included in the *Tank Memoirs* prepared at the turn of the century) are rather outdated and have not been compiled in all basins.

On the basis of data for the Palar basin, it would seem that the proportion of double crop tanks is considerably larger among non-system than system tanks. Non-system tanks have, on the average, lower storage capacity ($8278M^3$) per hectare of *ayacut* than system tanks ($10245M^3$). There is little difference between double crop system and non-system tanks in storage capacity per year per hectare of cropped area, the system tank average being marginally lower than non-system tanks. Much of the difference in these respects between system and non-system tanks is to be found in the single crop tanks *(Table 2.14)*.

Storage capacity per hectare of *ayacut* is much more variable in the non-system tanks than in system tanks taken as a whole as well as in respect of single and double crop tanks in these two categories. Within the non-system category, however, storage capacity per hectare is much more variable in double crop tanks than in single crop tanks, the reverse being the case in system tanks. The variability across double crop system tanks is markedly less than in single crop system tanks.

Most tanks serve one village, usually part of its lands; several villages have multiple tanks; a small number of tanks are multi-village tanks. The multi-village tanks are naturally relatively larger in size. Thus

Ayacut in hectares

	PWD Tanks								Ex-*zamin* tanks		All tanks		*Ayacut* per tank
200-400 ha		400-800 ha		800-2,000 ha		>2,000 ha		Total					
o	*Ayacut*	No	*Ayacut*	No	*Ayacut*	No	*Ayacut*	No	*Ayacut*	No	*Ayacut*	No	*Ayacut*	
4	30,726	29	15,140	9	9,082	3	9,931	1,243	1,59,950	720	7,328	3,746	185,294	49
	12,183	5	3,030	1	1,627	1	2,315	1,169	93,612	482	4,899	3,735	118,794	32
	13,160	10	4,733	4	4,939	4	35,310	757	1,01,716	79	810	2,602	120,826	46
	1,677	0	0	0	0	0	0	188	16,532	0	0	737	20,581	28
	1,257	0	0	1	970	0	0	101	9,197	154	1,579	1,834	19,562	11
	1,743	1	577	0	0	0	0	59	7,571	0	0	123	8,260	67
3	3,753	6	3,030	2	2,240	1	2,150	685	33,704	0	0	1,176	38,644	33
2	3,288	3	1,522	3	3,406	2	4,133	258	28,407	58	607	6,394	1,05,438	16
	5,197	1	668	0	0	0	0	530	38,165	214	2,186			
2	9,222	6	3,322	2	2,136	0	0	771	56,535	331	3,360	4,493	78,478	17
6	17,244	24	12,084	8	9,578	1	4,916	1,508	1,41,181	7,367	75,101	10,208	2,35,473	23
6	4,809	8	4,412	10	9,309	0	0	686	53,960	445	4,534	2,096	65,579	31
	1,168	0	0	0	0	0	0	984	10,602	0	0	2,058	14,934	7
	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	**1,05,426**	**93**	**48,520**	**40**	**43,286**	**12**	**58,754**	**8,939**	**7,51,133**	**9,850**	**1,00,405**	**39,202**	**10,11,862**	**26**

for example, of the 197 villages served by the Palar Anicut System (PAS), 128 are single tank villages, 66 are multi-tank villages and only three are multi-village tanks. Two of them (Kaveripakkam and Dusi-Mamandur) have *ayacuts* exceeding 5,000 acres each spread over 14 villages in one case and 18 in another.

MANAGEMENT OF TANKS

Tanks are classified into different categories for administrative purposes. In Andhra Pradesh, the Minor Irrigation Department is supposed to be responsible for maintenance, repairs and water regulation in tanks with *ayacuts* exceeding 400 hectares and for maintenance and repairs of tanks with *ayacuts* between 80 hectares, (40 hectares in Telengana) and 400 hectares. All smaller tanks are maintained by the *Panchayati Raj* institutions. In Tamil Nadu maintenance of tanks with less than 40 hectares *ayacut* is vested with the *panchayat* unions; while tanks with more than 40 hectares *ayacut* (and all system tanks) are under the PWD's care. In addition there are a large number of (nearly 10,000 in Tamil Nadu alone) ex-*zamin* tanks which remain to be properly surveyed and classified. In Karnataka the taluk boards maintain and repair small tanks with *ayacuts* below four hectares with water regulation being managed by the villagers. In the case of tanks with *ayacuts* between four and 80 hectares, the PWD takes care of maintenance/repairs and supervises water regulation. All these functions are vested with the PWD in tanks with *ayacuts* more than 80 hectares.

Details of the way these arrangements in fact work on the ground (and in particular the role of the *ayacutdars* and village institutions) have not been systematically documented. In Tamil Nadu the Panchayats and the PWD are supposed to take care of maintenance and upkeep of the supply channels, the tank *bund*, sluices and surplus weirs with funds made available from the state budget. The allocations however have been inadequate to ensure proper maintenance of irrigation facilities. There was a traditional system of *Kudimaramath* in respect of these structures. But their weakening in the wake of the advent of the British rule led to the state taking over the responsibility more than a century back. Though there are still several instances of farmers attending to the cleaning of the supply channels to ensure the supply of water to particular tanks, it is generally recognised that the attention and resources devoted to maintenance and upkeep remains inadequate.

Our knowledge of the maintenance of distribution networks and water management within tank

Table 2.7: Districtwise Size Distribution of Tanks in Andhra Pradesh, 1985-86 to 1987-88

Sl No	Districts	1985-86 to 1987-88						Avg. size of *ayacut* per tank (ha)*
		No of tanks with *ayacuts*			NIA by tanks (hectares) with *ayacuts*			
		> 40 ha	< 40 ha	Total	> 40 ha	< 40 ha	Total	
1	2	3	4	5	6	7	8	9
1.	Srikakulam	574	7,699	8,273	20,950	0	20,950	8
2.	Vizianagaram	589	8,746	9,335	12,694	15,436	28,130	7
3.	Visakhapatnam	348	4,767	5,115	6,480	20,184	26,664	7
4.	East Godavari	158	1,863	2,021	16,135	16,135	32,270	15
5.	West Godavari	528	1,344	1,872	6,489	10,989	17,478	27
6.	Krishna	265	638	903	8,735	2,888	11,623	30
7.	Guntur	68	171	239	1,418	1,300	2,718	11
8.	Ongole (Prakasam)	253	538	791	26,345	11,339	37,684	38
9.	Nellore	557	1,039	1,596	76,795	20,839	97,634	58
	Coastal Andhra Region	3,340	26,805	30,145	1,76,041	99,110	2,75,151	13
10.	Kurnool	92	301	393	10,934	3,072	14,006	29
11.	Anantapur	266	737	1,003	6,387	6,913	13,300	9
12.	Cuddapah	305	1,866	2,171	7,902	4,790	12,692	4
13.	Chittoor	470	7,139	7609	16,187	21,026	37,213	6
	Rayalaseema Region	1,133	10,043	11,176	41,410	35,801	77,211	7
	Andhra Region	4,473	36,848	41,321	2,17,451	1,34,911	3,52,362	12
14.	Rangareddy	324	11,706	12,030	4,355	3,883	8,238	1
15.	Hyderabad	1	14	15	0	55	55	1
16.	Nizamabad	319	1,358	1,677	13,134	9,051	22,185	18
17.	Medak	512	4,425	4,937	19,441	27,333	46,774	8
18.	Mahbubnagar	403	4,510	4,913	8,220	7,383	15,603	2
19.	Nalgonda	447	5,061	5,508	7,465	7,698	15,163	3
20.	Warangal	614	3,843	4,457	47,718	50,014	97,732	18
21.	Khammam	366	1,973	2,339	22,627	22,324	44,951	23
22.	Karimnagar	531	6,116	6,647	24,486	19,766	44,252	7
23.	Adilabad	132	1,245	1,377	5,525	10,111	15,636	13
	Telengana Region	3,649	40,251	43,900	1,52,971	1,57,618	3,10,589	7
	Andhra Pradesh	8,122	77,099	85,221	3,70,422	2,92,529	6,62,951	9

Note:* Since the registered *ayacut* figures of tanks in Andhra Pradesh are not readily available, we have used, for the sake of comparison, "three years' average" of both the number of tanks and the NIA by tanks (1985-86 to 1987-88) to compute the "size of *ayacut* per tank".

Source: GOAP, Season and Crop Report, Hyderabad, Various Issues.

ayacuts is inadequate. The available descriptions (Venkatram 1985) suggest that, except in Tamil Nadu, the government (through PWD/Revenue/Minor Irrigation Department) has the responsibility for regulation of water in the relatively large tanks and supervise regulation by local officers in smaller tanks. In Andhra Pradesh water release in large tanks is supposed to be done by the *patwari* through a *neerkati* who takes orders from the village official. In small (Zilla Parishad) tanks the cultivators manage these tanks through *neerkatis* appointed by them. In Karnataka the water regulators (*soudis*) in tanks with *ayacuts* exceeding 80 hectares are supposed to be appointed by the PWD and work under the supervision of a committee comprising officials of the revenue/agriculture departments and PWDs. In Maharashtra the government is supposed

Table 2.8: District-wise Size Distribution of Minor Irrigation Works in Karnataka, 1992

Sl No	Districts	As on 01-04-1992						Average size of *ayacut* (8/7)
		< 40 ha		> 40 ha		Total		
		Number	*Ayacut* (ha)	Number	*Ayacut* (ha)	Number	*Ayacut* (ha)	
1	2	3	4	5	6	7	8	9
1.	South Kanara	1,080	11,522	148	6,495	1,228	18,017	14.7
2.	North Kanara	3,341	13,563	118	18,672	3,459	32,235	9.3
	Coastal Region	4,421	25,085	266	25,167	4,687	50,252	10.7
3.	Chikmagalur	3,051	17,899	160	24,496	3,211	42,395	13.2
4.	Hassan	5,516	40,738	142	18,994	5,658	59,732	10.6
5.	Kodagu	1,282	12,598	49	4,442	1,331	17,040	12.8
6.	Shimoga	6,277	51,776	379	30,237	6,656	82,013	12.3
	Eastern Region	16,126	1,23,011	730	78,169	16,856	2,01,180	11.9
7.	Belgaum	740	8,937	278	45,891	1,018	54,828	53.9
8.	Bellary	221	4,396	77	12,374	298	16,770	56.3
9.	Bidar	68	938	71	17,715	139	18,653	134.2
10.	Bijapur	61	1,061	150	33,457	211	34,518	163.6
11.	Chitradurga	266	5,192	210	26,736	476	31,928	67.1
12.	Dharwar	2,775	21,799	419	51,851	3,194	73,650	23.1
13.	Gulbarga	565	7,946	148	23,413	713	31,359	44.0
14.	Raichur	634	5,113	87	17,229	721	22,342	31.0
	Northern Region	5,330	55,382	1,440	228,666	6,770	2,84,048	42.0
15.	Bangalore (R)	1,499	13,278	202	25,670	1,701	38,948	22.9
16.	Bangalore (U)	509	5,454	69	6,564	578	12,018	20.8
17.	Kolar	4,151	39,164	333	31,689	4,484	70,853	15.8
18.	Mandya	1,145	13,511	249	22,825	1,394	36,336	26.1
19.	Mysore	1,321	10,196	193	30,392	1,514	40,588	26.8
20.	Tumkur	1,912	22,075	438	49,453	2,350	71,528	30.4
	Southern Region	10,537	1,03,678	1,484	166,593	12,021	2,70,271	22.5
	Karnataka State	36,414	3,07,156	3,920	498,595	40,334	8,05,751	20.0

Note: * Included *Anicuts* + Pickups + *Bhandaras* and Other M I Works.
Source: GOK, Minor Irrigation Statistics at a Glance, 1991-92, Department of Irrigation, Bangalore, 1992.

to appoint *chowkidars, patwaris* (water regulators) and canal inspectors for each tank depending on its size. Whether these officials are to regulate releases from the tank or the actual distribution of water in the *ayacut* is not clear. Nor is the relative role of village bodies and officials.

COMMUNITY MANAGEMENT OF TANKS

A number of studies describing current conditions of specific tanks in Tamil Nadu and their management are available (see Chambers 1977, Palanisamy and Easter 1983, MIDS 1986, Vaidyanathan and Janakarajan 1989, Mohanakrishnan 1990, Sengupta 1991, Janakarajan 1993, Sivasubramaniyan 1995, Ramanathan and Rajagopal 1996). Though limited in scope and coverage they do show that the PWD is solely responsible for maintenance and repair of inlet channels, and the physical structures of all system tanks and others with *ayacutdars* of more than 40 ha. But, except in a few large multi-village tanks, it does not have anything to do with maintenance of the distribution network, operating sluices and regulating water allocation within the

Map 2.5: Distribution of Tanks and *Ayacuts* in the Three Southern States of India Average Size of Tanks

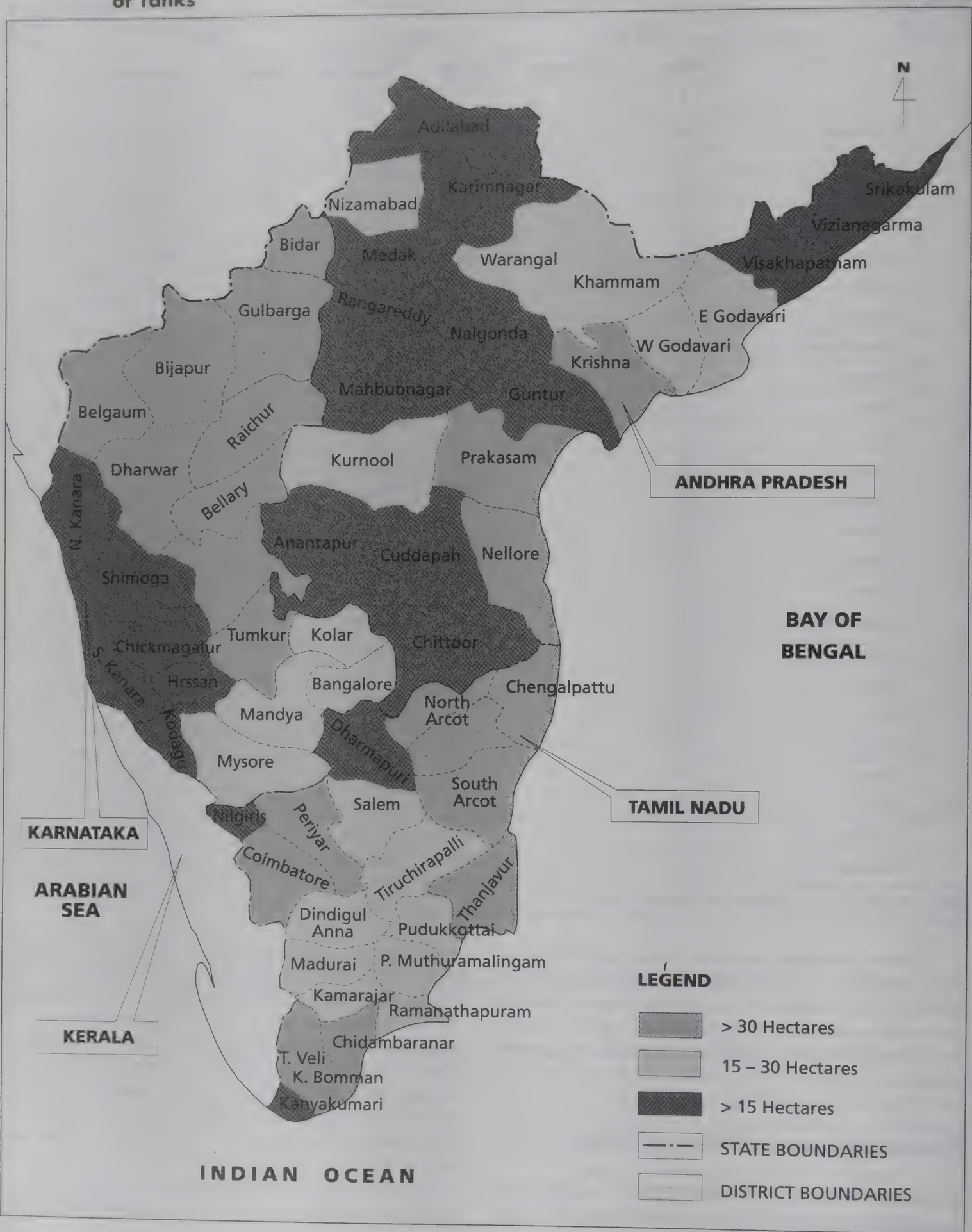


Table 2.9: Number of Tanks and Net Irrigated Area (NIA) by them in Andhra Pradesh, Karnataka and Tamil Nadu from 1950–51 to 1992–93

(NIA in 000 hectares)

Year	Andhra Pradesh				Karnataka				Tamil Nadu							
	Number of tanks			NIA by tanks	Number of tanks			NIA by tanks	Number of tanks			NIA by tanks	Rainfall in mm			
	> 40 ha	< 40 ha	Total		> 40 ha	< 40 ha	Total		> 40 ha	< 40 ha	Total		June to Sep	Oct to Dec	Jan.to May	June to May
1	2	3	4	5	2	3	4	5	2	3	4	5	6	7	8	9
1950-51	6137	11700	17837	480	NA	NA	NA	NA	7525	15459	22984	545.4	283	350	215	848
1951-52	6662	16724	23386	495	NA	NA	NA	NA	6435	17380	23815	635.7	335	325	158	818
1952-53	6487	19871	26358	513	NA	NA	NA	283.2	6793	18378	25171	617.8	198	368	183	748
1953-54	6464	19989	26453	629	NA	NA	NA	303.8	6652	18512	25164	795.5	390	405	263	1058
1954-55	5935	19576	25511	591	NA	NA	NA	310.2	6628	18613	25241	861.9	335	415	300	1050
1955-56	NA	NA	NA	621	NA	NA	NA	320.1	7276	17798	25074	794.4	340	420	96	856
1956-57	NA	NA	NA	1180	3259	31412	34671	327.5	7327	20117	27444	884.3	395	450	153	998
1957-58	9883	48923	58806	1112	4880	35280	40160	335.6	6994	21366	28360	847.4	330	500	230	1060
1958-59	11450	44992	56442	1192	3612	33478	37090	347.7	7459	21013	28472	840.1	343	401	172	916
1959-60	NA	NA	NA	1255	2964	34970	37934	346.1	6986	22612	29598	832.8	342	459	168	969
1960-61	15708	48768	64476	1151	2988	34027	37015	343.7	7150	22753	29903	936.4	349	580	195	1124
1961-62	NA	NA	NA	1258	3108	33468	36576	360.1	7030	27437	34467	939.5	371	309	187	867
1962-63	7520	52231	59751	1331	3005	33595	36600	370.3	7220	27703	34923	946.2	325	395	212	932
1963-64	7934	52649	60583	1227	3081	35489	38570	376.9	7562	29246	36808	914.9	315	506	87	908
1964-65	NA	NA	NA	1341	4175	35591	39766	371.5	7842	28323	36165	892.2	347	406	106	859
1965-66	8043	53263	61306	1189	3319	33663	36982	324.3	8611	26730	35341	902.5	315	441	115	871
1966-67	8007	53538	61545	1258	NA	NA	NA	321.0	8183	28187	36370	965.8	416	606	139	1161
1967-68	8414	55334	63748	1220	NA	NA	NA	339.0	8452	28180	36632	989.9	285	496	179	960
1968-69	8191	56341	64532	773	2922	34696	37618	350.5	8442	28193	36635	750.5	271	312	100	683
1969-70	8339	59283	67622	1071	2672	35164	37836	372.8	8726	27019	35745	879.2	238	613	186	1037
1970-71	7571	59531	67102	1112	2489	31879	34368	364.8	8544	27278	35822	897.9	318	420	180	918
1971-72	7401	59987	67388	813	2739	31174	33913	374.1	9358	28056	37414	923.5	323	489	147	959
1972-73	7787	63704	71491	807	2814	33284	36098	362.1	9286	27917	37203	949.5	304	608	79	991
1973-74	7618	66098	73716	1028	NA	NA	NA	366.0	8093	29776	37869	928.5	333	407	102	842
1974-75	7395	66114	73509	950	2789	32489	35278	370.0	8427	29547	37974	593.9	326	178	143	647
1975-76	7368	66648	74016	1100	2912	32688	35600	410.3	7386	30593	37979	749.8	420	340	97	857
1976-77	7384	66929	74313	1089	NA	NA	NA	256.0	7412	30923	38335	800.0	314	440	187	941
1977-78	7395	67122	74517	912	NA	NA	NA	348.0	7480	31461	38941	909.9	333	682	109	1124
1978-79	7424	66750	74174	1140	NA	NA	NA	348.0	7402	30795	38197	841.9	261	582	107	950
1979-80	7343	66705	74048	749	3002	31521	34523	343.7	7398	30896	38294	896.2	361	605	125	1091
1980-81	NA	NA	NA	900	3021	31550	34571	303.7	7399	30895	38294	590.2	196	337	136	669
1981-82	NA	NA	NA	1045	3072	31542	34614	321.3	7408	30896	38304	738.4	406	453	97	956
1982-83	7330	66473	73803	853	NA	NA	NA	295.0	7116	30828	37944	516.6	217	352	94	663
1983-84	7375	66630	74005	1087	NA	NA	NA	316.6	7125	30591	37716	807.1	399	484	340	1223
1984-85	NA	NA	NA	774	NA	NA	NA	326.0	7191	30438	37629	715.0	331	300	160	791
1985-86	6356	58820	65176	786	NA	NA	NA	242.0	7224	30421	37645	671.7	382	377	192	951
1986-87	7110	65674	72784	777	NA	NA	NA	259.0	7200	30749	37949	509.6	272	331	98	701
1987-88	8122	77099	85221	663	NA	NA	NA	258.0	7280	30949	38229	609.9	271	525	187	983
1988-89	NA	NA	NA	1104	NA	NA	NA	324.1	7282	31067	38349	479.0	376	218	115	709
1989-90	NA	NA	NA	1026	NA	NA	NA	281.6	7281	31202	38483	522.7	349	341	227	917
1990-91	NA	NA	NA	NA	NA	NA	NA	240.0	7281	31202	38483	530.9	239	373	103	715
1991-92	NA	NA	NA	NA	NA	NA	NA	297.0	7299	31453	38752	577.0	332	485	82	899
1992-93	NA	NA	NA	NA	NA	NA	NA	NA	7176	31687	38863	628.8	316	477	69	862
1993-94	NA	NA	NA	NA	NA	NA	NA	NA	7164	31678	38842	668.1	305	710	78	1172

Note: Seasonwise Rainfall data for AP, Karnataka are not readily available; NA = not available.

Source: 1. GOAP, GOK, and GOTN, Season and Crop Reports, Various Issues. 2. GOI, Indian Agricultural Statistics, Vol.I, Various Issues, Directorate of Economics and Statistics, Ministry of Agriculture, New Delhi. 3. Statistical Abstract of Andhra Pradesh and Karnataka.

Table 2.10: Districtwise Details of PWD Tanks in Tamil Nadu, 1977

(*Ayacut* in hectares)

Sl No	District	System tanks			Non-system tanks			Total		
		No	*Ayacut*	Average size	No	*Ayacut*	Average size	No	*Ayacut*	Average size
1.	Chengai-MGR	75	14,857	198	1,168	1,45,092	124	1,243	1,59,950	129
2.	North Arcot Ambedkar T V Malai Sambuvarayar	537	40,180	75	632	53,432	85	1,169	93,612	80
3.	South Arcot	184	46,926	255	573	54,790	96	757	1,01,716	134
4.	Salem	0	0	0	188	16,532	0	188	16,532	88
5.	Dharmapuri	3	1,234	411	98	7,963	81	101	9,197	91
6.	Coimbatore + Periyar	2	189	95	57	7,382	130	59	7,571	128
7.	Thanjavur	680	33,253	49	5	451	90	685	33,704	49
8.	Tiruchirapalli	85	12,489	147	173	15,918	92	258	28,407	110
9.	Pudukkottai	161	8,206	51	369	29,958	81	530	38,165	72
10.	Madurai + Anna	483	26,663	55	288	29,872	104	771	56,535	73
11.	Ramanathapuram +, PMT + Kamarajar	130	2,598	20	1,378	1,38,583	101	1,508	1,41,181	94
12.	T.Veli Kattabomman + Chidambaranar	397	21,932	55	289	32,028	111	686	53,960	79
13.	Kanyakumari	960	7,768	8	24	2,834	118	984	10,602	11
14.	Nilgiris	0	0	0	0	0	0	0	0	0
Total		**3,697**	**2,16,296**	**59**	**5,242**	**5,34,837**	**102**	**8,939**	**7,51,133**	**84**

Source: GOTN, Chief Engineer for Minor Irrigation, PWD, Madras, 1977.

ayacut. These functions are left to be managed entirely by the *ayacutdars*.

The studies further show that most of the tanks surveyed are functioning and are managed by informal local institutions governed by custom and tradition dating back to the pre-British time. The rules and conventions are for the most part, transmitted informally but in a few cases they have been written down by British administrators. The *Mamulnamas* for North Arcot tanks, published in the 19th century being a case in point (for details see GOM. 1907). Even in the 19th century it was widely believed that these traditional arrangements were breaking down. And this belief is widespread in our own time. However, recent studies cited above show that while local tank management institutions are not uniformly effective, and there have been considerable changes, there is no warrant for the belief that they have become wholly defunct or ineffective.

Indeed a large proportion of communities studied were found to have well-defined rules regarding the contributions by *ayacutdars* for maintenance and managing water allocation, as well as enforcement mechanisms. In many cases the communities are actively involved in collective action for appropriation of water, maintenance of distribution networks in the *ayacut* when water is available, and in regulating water use (especially in times of shortage) through functionaries specifically appointed for the purpose. Available studies also show that the village level organisations have undergone changes because of vast increase in the number of *ayacutdars*, shift in land control from a small to a large number of land-owners, changes in the attitude of farmers, and the spread of well irrigation in the tank *ayacuts*. As a result, the arrangements have modified but have not broken down. There is still a strong tendency to invoke customs and tradition in managing irrigation supplies.

PROGRAMMES FOR TANK IRRIGATION

As noted already the meagre outlays on minor surface irrigation reflect the relatively low priority attached to extending and improving this source of water. The distribution of these outlays between tanks and other types of minor works and between rehabilitation of existing facilities and construction of new ones is not available. It may be noted in passing that apart from allocations under "minor irrigation", desilting and repair

Table 2.11: Systemwise Details of PWD Tanks in Tamil Nadu, 1977

Sl No	Name of the basin	Name of the system	Districts benefited	No of tanks	*Ayacut* (Ha)
1	Cauvery	Lower Coleroon Anicut System	South Arcot	3	20,224
	Cauvery	Cauvery Delta System	Thanjavur	25	6,139
	Cauvery	Cauvery Mettur Project	Thanjavur	583	24,746
			Pudukkottai	161	8,206
	Cauvery	Kattalai Scheme	Thanjavur	8	725
			Tiruchirapalli	11	1,778
	Cauvery	New Kattalai High Level Canal	Thanjavur	64	1,643
			Tiruchirapalli	44	2,457
	Cauvery	Pullambadi Canal	Tiruchirapalli	28	6,213
	Cauvery	Nandiyar Channel System	Tiruchirapalli	2	2,041
	Cauvery	Kodiveri Anicut System	Periyar	2	189
	Basin total			**931**	**74,362**
2	Palar	Palar Anicut System	Chengai-MGR	71	9,406
			North Arcot Ambedkar	241	22,528
	Palar	Ponnai Anicut System	North Arcot Ambedkar	128	9,120
	Palar	Cheyyar Anicut System	Chengai-MGR	3	180
			North Arcot Ambedkar	140	7,883
	Basin total			**583**	**49,117**
3	Periyar-Vaigai	Periyar System	Madurai	385	23,999
	Periyar-Vaigai	Vaigai Reservoir System	Madurai	98	2,664
			Pasumpon Muthuramalinga Thevar	130	2,598
	Basin total			**613**	**29,262**
4	Tambraparani	Marudur Anicut System	Tirunelveli Kattabomman	31	5,264
	Tambraparani	Srivaikuntam Anicut System	Tirunelveli Kattabomman	23	7,348
	Tambraparani	Manimuthar Reservoir System	Tirunelveli Kattabomman	343	9,319
	Basin total			**397**	**21,932**
5	Vellar	Mehamathur *Anicut* System	South Arcot	11	1,907
	Vellar	Tholudur Anicut System	South Arcot	25	525
	Vellar	Pelandurai Anicut System	South Arcot	18	3,150
	Vellar	Vridhachalam Anicut System	South Arcot	13	2,214
	Vellar	Sethiathope Anicut System	South Arcot	8	10,603
	Basin total			**75**	**18,399**
6	Ponnaiyar	Sathanur Reservoir System	North Arcot Ambedkar	28	649
			South Arcot	10	399
	Ponnaiyar	Thirukoilur Anicut System	South Arcot	96	7,903
	Ponnaiyar	Barur Tank System	Dharmapurai	1	970
	Ponnaiyar	Krishnagiri Reservoir System	Dharmapurai	2	264
	Basin total			**137**	**10,186**
7	Kodayar	Kodayar System	Kanyakumari	960	7,768
8	Madras (Coovam)	Chembarambakkam Tank System	Chengai-MGR	1	5,271
		Total		**3,697**	**2,16,296**

Source: GOTN, Chief Engineer for Minor Irrigation, PWD, Madras, 1977.

of tanks can be, and are, done under Jawahar Rojgar Yojana and other poverty alleviation schemes; even as watershed development projects include construction of percolation ponds and other small local storages. There is no information on the magnitude and nature of schemes implemented under these programmes.

In general, the emphasis seems to have been mainly on repair, rehabilitation and modernisation of existing tanks rather than on constructing new ones. Judging from the trend in the number of tanks (as reported in the Season and Crop Reports) and in the potential of minor surface works, construction of new tanks has occured on a significant scale in Andhra Pradesh. Thus from *Table 2.9* it is seen that the number of tanks in Andhra Pradesh rose from about 60,00 in the early 1960s to over 80,000 in the mid-eighties. The number of tanks in the other two

Table 2.12: Districtwise Distribution of PWD Tanks in Andhra Pradesh by Size of *Ayacut*, 1994

(hectares)

Sl No	Districts	System tanks								Non-system tanks								All tanks		
		40 to 80	80 to 120	120 to 160	160 to 200	200 to 400	400 to 800	800 to 2,000	Total	40 to 80	80 to 120	120 to 160	160 to 200	200 to 400	400 to 800	800 to 2,000	above 2,000	Total	Total	< 200 ha
1.	Srikakulam	151	63	20	12	8	–	3	257	332	94	21	10	5	–	–	–	462	719	703
2.	Vizianagaram	162	31	7	7	9	3	–	219	268	107	17	9	11	–	–	–	412	631	608
3.	Visakhapatnam	136	27	13	7	9	–	–	192	152	28	13	1	5	1	–	–	200	392	377
4.	East Godavari	0	0	0	0	–	–	–	0	176	51	24	12	12	3	1	1	280	280	263
5.	West Godavari	57	29	13	6	13	8	–	126	144	26	7	5	9	3	–	–	194	320	287
6.	Krishna	17	11	4	1	1	1	–	35	126	56	16	8	8	7	–	–	221	256	239
7.	Guntur	0	2	1	1	–	1	–	5	20	8	2	2	2	3	–	–	37	42	36
8.	Prakasam	12	5	2	3	14	2	–	38	124	54	20	13	20	9	4	–	244	282	233
9.	Nellore	0	0	0	0	–	–	–	0	258	133	67	40	61	28	10	–	597	597	498
	Coastal Andhra Region	535	168	60	37	54	15	3	8,72	1,600	557	187	100	133	54	15	1	2,647	3,519	3,244
10.	Kurnool	0	0	0	0	–	–	–	0	70	31	16	11	19	6	3	–	156	156	128
11.	Anantapur	1	0	0	0	–	–	–	1	180	66	27	25	34	10	6	–	348	349	299
12.	Cuddapah	0	0	0	0	–	–	–	0	107	37	23	15	15	9	1	–	207	207	182
13.	Chittoor	16	9	3	1	4	3	–	36	333	101	43	16	23	14	–	–	530	566	522
	Rayalaseema Region	17	9	3	1	4	3	0	37	6,90	235	109	67	91	39	10	0	1,241	1,278	1,131
	Andhra Region	552	177	63	38	58	18	3	909	2,290	792	296	167	224	93	25	1	3,888	4,797	4,375
14.	Rangareddy	0	0	0	0	–	1	–	1	126	42	12	5	8	7	3	1	204	205	185
15.	Hyderabad	0	0	0	0	–	–	–	0	0	0	0	0	–	–	–	–	0	0	0
16.	Nizamabad	0	0	0	0	–	–	–	0	289	76	47	12	26	5	–	–	455	455	424
17.	Medak	7	4	0	0	–	–	–	11	398	100	45	14	18	8	4	–	587	598	568
18.	Mahbubnagar	0	0	0	0	–	–	–	0	429	127	50	14	28	5	1	–	654	654	620
19.	Nalgonda	60	2	11	9	9	3	2	96	368	96	41	11	22	2	1	–	541	637	598
20.	Warangal	0	0	0	0	–	–	–	0	462	139	58	32	34	11	2	–	738	738	691
21.	Khammam	0	0	0	0	–	–	–	0	166	90	33	16	28	11	6	1	351	351	305
22.	Karimnagar	0	0	0	0	–	–	–	0	356	108	46	25	33	9	2	–	579	579	535
23.	Adilabad	0	0	0	0	–	–	–	0	231	46	20	16	12	8	1	–	334	334	313
	Telengana Region	67	6	11	9	9	4	2	108	2,825	824	352	145	209	66	20	2	4,443	4,551	4,239
	Andhra Pradesh	619	183	74	47	67	22	5	1,017	5,115	1,616	648	312	433	159	45	3	8,331	9,348	8,614

Note: – indicates Nil.

Source: GOAP, Irrigation and Command Area Development Department, Letter from Chief Engineer in response to our querries on minor irrigation tanks in Andhra Pradesh, 1994.

states has not shown much of an increase; it has in fact fallen in Karnataka. The potential created as reported by the CBIP *(Table 2.15)* has increased in all three states: by about 14 per cent in Tamil Nadu and nearly two-thirds in Andhra Pradesh and Karnataka over the period 1960-61 to 1989-90.

The reliability of figures of irrigation potential and utilisation computed by the Central Board of Irrigation and Power (CBIP) however is open to doubt. The concepts are unclear and estimates are based on reports sent by state PWD or minor irrigation department which have shown little interest in, and are not equipped for, proper monitoring and verification of field reports on the basis of objective surveys of ground reality. That the CBIP figures are seriously at odds with those published in land use statistics only adds to the confusion.

Table 2.13: Technical Relationships of Different Tank Sizes (Average for Tanks)

Size of tanks (acres)	No of tanks	Settled command area (SCA) in acres	Water spread area (WSA) in acres	Total storage capaciy (TSC) in mcft	WSA/SCA (4/3) (in acres)	TSC/SCA (5/3) ('000 cu.feet/acre)	Average depth 5/(4*.04356) (feet)
1	2	3	4	5	6	7	8
>1000	9	1,964	1,545	413.0	0.79	210	6.14
500-1000	8	710	786	144.0	1.11	203	4.21
200-500	13	318	316	55.5	0.99	175	4.03
100-200	9	150	197	32.5	1.31	217	3.79
<100	6	73	85	12.5	1.16	171	3.38
All Tanks	45	651	591	132.4	0.91	203	5.14

Source: Von Oppen and Subba Rao, Tank Irrigation in Semi-Arid Tropical India, Mimeo, ICRISAT, 1980a, p.9.

The number of tanks reported to be in use in 1986-87 at the time of the special census of minor irrigation is considerably less than the number reported by the PWD, which are again at variance from figures given in other official reports. The total number of tanks in Andhra Pradesh, Karnataka and Tamil Nadu as per PWD records is around 1,50,000 while the MI census reports the number in use to be 1,17,000. Data compiled by revenue department and published in the Season and Crop Reports, however, do not show any significant declining trend in the number of tanks in any of the three states; if anything this series points to is an increase in the number of tanks in Andhra Pradesh and Tamil Nadu. The PWD does not, and is not, equipped to maintain and systematically update information on the state of tanks. The criteria to determine whether or not a tank is "in use" or "out of use" are also ill defined. In any case, the number of tanks is a poor measure; what is more relevant is the area irrigated.

According to the CBIP, minor surface works in AP, Karnataka and Tamil Nadu had, in 1960-61, the potential to irrigate about 1.9 million ha but actual area irrigated by this source as per land use data was nearly 50 per cent higher at 2.9 million ha. The difference between the two sets of figures being as much as 85 per cent in Andhra Pradesh and 29 per cent in Tamil Nadu. The divergence in the time profile of change in minor surface irrigation shown by the two agencies is even more striking. According to CBIP, the potential of surface minor works has increased substantially in the three states; the increase between 1960-1 and 1989-90 ranging between 13-14 per cent in Tamil Nadu and by nearly two-thirds in Andhra Pradesh and Karnataka. By contrast actual area irrigated under this category was substantially higher than CBIP estimate of potential in the early 1960s; but has been on a declining trend since then. In the event, in all three states net irrigated area under minor surface sources during the latter half of the 1980s was not only substantially lower than in the early 1960s but also much less than the potential reported by CBIP.

If it is difficult to reconcile these differences in area estimates, as we know next to nothing about the trend in the quantum of water supply, the quality of its management or its impact on production and productivity. There is hardly any information on these aspects even from carefully done micro surveys of individual

Table 2.14: Storage Capacity and Quantity of Water Available per Hectare in Different Categories of Tanks in the Palar Basin

Category	No of tanks	Storage capacity/ha. of *ayacut* (mean) (MCM)	CV (%)	Water available ha/crop (mean)	(%) CV
Single crop rainfed tanks	440	8,291	186	13,442	230
Single crop system tanks	416	11,005	202	14,926	217
Double crop rainfed tanks	322	8,261	362	13,209	449
Double crop system tanks	149	8,122	101	9,536	139
All rainfed tanks	762	8,278	274	13,245	338
All System tanks	565	10,245	191	13,505	213

Note: CV = Coefficient of variation.
Source: Based on the analysis of data for tanks in the Palar Basin Compiled by the Institute of Water Studies, Tharamani, (nd).

Table 2.15: Potential and Utilisation of Area Irrigated by Minor Surface Works in the Three Southern States of India

(Area in '000 hectares)

States	Net irrigated area by minor surface sources *					NIA actual **			
	1960–61 Potential	1968–69 Potential	1979–80 Potential	1989–90		All minor surface sources		Tanks	
				Potential	Utilisation	1960–64	1985–89	1960–64	1985–89
Andhra Pradesh	753	756	940	1,255	1,102	1,389	1,002	1,262	871
Karnataka	428	431	595	715	690	505	529	365	273
Tamil Nadu	753	756	797	857	852	969	576	926	559
India	6,454	6,512	8,000	11,150	10,100	7,074	5,426	4,638	2,740

Note: Figures relating to potential of all minor surface works in all specified years and estimated utilisation in 1989-90 are taken from * GOI, Central Board of Irrigation and Power, Statistics of Minor Irrigation Development, New Delhi. pp 13-14, 1989. It needs noting that in the case of Andhra Pradesh, the potential as given in the above source is substantially less than reported in an unpublished paper presented by Koteswara Rao, Chief Engineer, PWD (1992). According to this paper, the potential was 1,352 thousand hectares in 1950-51 and 1,844 thousand hectares in 1989-90. Unfortunately, unlike in Tamil Nadu and Karnataka, we could not get official PWD publications on number of minor surface sources and their *ayacuts* in Andhra Pradesh. ** GOI., Indian Agricultural Statistics, 1985-86 — 1989-90, Vol I, (Summary Tables), New Delhi, 1992. NIA., Net irrigated area.

tanks, leave alone surveys of a representative sample of tanks. Without such information meaningful assessment of the impact of the various programmes and their economic reliability is well-nigh impossible.

That even the restoration of tank irrigation, not to speak of its expansion, has been neglected under the regime of planning is brought out in a recent study of Andhra Pradesh. Koteswara Rao (1992) reports that nearly 80 per cent of the tanks in Andhra are rated sub-standard and easily vulnerable to cyclone and flood damage. Hundreds of tanks are getting damaged year after year due to floods and other causes. In the early 1990s, 600 breached tanks and 100 more abandoned tanks were estimated to be in need of restoration. Overall, the area reported to be actually irrigated by tanks was only half the registered *ayacut*. Except for nominal grants for temporary repairs, no formal budget allocations were made for permanent restoration of breached tanks or for making necessary improvement.

The story is similar in Karnataka where the area reported to be actually irrigated in 1975-76 was about 68 per cent of the registered *ayacut*. Despite the construction of several new tanks (whose number is not known but whose *ayacut* is estimated at 41,500 hectares). the area under tank irrigation has actually declined by nearly 81,000 hectares and constitutes only 50 per cent of the registered *ayacut* (Dikshit et al 1994: 128-129). Inadequate rainfall and silting cannot really explain this gap and certainly not the progressive increase in the extent of underutilisation.

THE TAMIL NADU PROGRAMME

That tank development programmes suffer from serious deficiencies both in concept and implementation is evident from the Tamil Nadu experience on which we have more information. Tamil Nadu has been implementing a number of programmes for tank irrigation mostly through the minor irrigation department of the PWD. Of these the Special Minor Irrigation Programme (SMIP) and Desilting–Cum–Restoration (DCR), schemes date back to the fifties. The SMIP envisages the formation of new tanks and percolation ponds, construction of *anicuts*, excavation of link channels and restoration of the abandoned tanks. DCR, as the name suggests, aims at removing accumulated silt in the tankbed, clearing foreshore encroachment and bringing the tanks to their rated capacity.

The Accelerated Minor Irrigation Programme (AMIP) — meant specifically for the Panchayat Union and the ex-*zamin* tanks — is of more recent origin. These tanks are relativley small and have probably suffered from past neglect much more than the PWD tanks. The aim again is to standardise existing structures, provide sluices and excavate supply channels as needed to achieve to full potential of these tanks. The Eighth Plan speaks of a phased programme, learning from the experience of the tank modernisation scheme with EEC assistance, planned basinwise studies taking into account the overall effect on the basin and the chain of tanks in the basin (GOTN 1990). But no details are available.

The late 1970s saw a bold initiative for tank modernisation of much broader scope focussing mainly on large tanks. A report prepared by the PWD (GOTN 1979) visualised a five-year programme to modernise nearly 500 tanks and improve water management at an estimated cost of Rs 2,000 million. The main ingredients of the programme included:

(1) Identification of defects and remedial measures needed in respect of supply channels, tank *bunds*

surplussing arrangements and sluices.

(2) Improvement in the distribution network through lining and installation of control structures.

(3) Command area development by dividing the *ayacut* into a number of compact blocks, and constructing roads, OFD works, drainage, etc.

(4) Introduction of rotation system of irrigation to provide assured, regulated and equitable supply of water to all segments of the *ayacut* under the supervision of the PWD staff advised by a committee of farmers.

(5) Strengthening of the agricultural extension staff.

These measures were expected to save water and increase the area irrigated with the available water (from an estimated 6 acres/mcft to 7.5 acres/mcft). As a result the gap between registered and actual *ayacuts* would be bridged; some new areas under irrigation brought under irrigation; and an extra crop could be raised on parts of the existing *ayacuts*.

This marks a major departure in the government's earlier approach to tanks. Particularly noteworthy is its heavy emphasis on a major programme for "improving" the distribution network in the *ayacut* at state expense; the government taking a direct responsibility for water distribution within the *ayacut* and extending the concept of command area development evolved in the case of larger projects to the tank commands as well. "Improvement and modernisation" of distribution networks was by far the largest component of the proposed investment.

The programme was estimated to cost nearly Rs 2,000 million at 1981-82 prices. The average investment works out Rs 7,200 per hectare of registered *ayacuts* and Rs 35,000 per hectare of estimated additional potential created. Though the cost was high, the benefits were expected to be large enough to make the programme economically viable. The state's five-year plan for 1978-83 in fact made a substantial allocation for a scheme to improve tanks in selected districts through "...watershed development to prevent further soil erosion and deposition in the tanks; ...increasing capacity of tanks; and ...developing *ayacut* by better water and crop management". In the event, this programme did not really take off.

The EEC showed interest in giving assistance for tank modernisation along the above lines but focussing on small, non-system PWD tanks. This eventually led to EEC tank modernisation programme. Launched in the early 1980s, it has become by far the largest component of tank improvement programmes of the minor irrigation department *(Table 2.16)*. The Eighth Plan also provided for substantial outlays from the state's own funds for accelerating work on *panchayat* union and ex-*zamin* tanks, as well as for standardisation and improvement of other tanks.

Construction, desiltation and repair of tanks, percolation ponds and other minor surface works are also part of (a) the soil and moisture conservation programme (including watershed development) and special area programmes (such as DPAP) which fall under the purview of the agriculture department, as well as (b) community development and poverty alleviation programme (especially Jawahar Rojgar Yojana) administrered by the rural development department. The magnitude of expenditure on tanks and minor surface works incurred under these programmes (or of their physical attainments) cannot be ascertained from any published source.

Data on the achievements (in terms of number and location of tanks covered, nature of works done and impact on water supply and area irrigated) of even programmes under the PWD are very scanty. There is simply no arrangement in PWD to cross-check the veracity of reports from field offices on works done, much less to undertake objective assessments of their impact. All that we know from the plan documents is the outlay and the "area benefitted" under SMIP/DCR and EEC schemes as reported by the PWD. But these figures are difficult to interpret: For it is unclear

Table 2.16: Outlays on Minor Surface Irrigation in Tamil Nadu

(Rs million)

Programme	1980-85	1985-89	1990-92	1992-97
Special Minor Irrigation Programme:	327.8	210.8	2.71	150.0
Desilting-Cum-Reclamation:	–	62.6	2.53	30.0
EEC Tank Modernisation Project:	–	311.6	908.27	800.0
Others:	14.7	–	–	700.0
Total	**342.5**	**585.0**	**913.51**	**1,680.0**

Note: "Others" include strengthening of P U tanks, standardisation of ex-*zamin* tanks, modernisation of 2,500 tanks, standardisation of supply channels; – indicates nil.
Source: GOTN, Tamil Nadu State Planning Commission, VII Five Year Plan 1985-90. GOTN, Tamil Nadu State Planning Commission, VIII Five Year Plan 1992-97, 1993. GOTN, Tamil Nadu an Economic Appraisal, 1992-93, Madras.

whether "area benefitted" relates to the total *ayacuts* of tanks in which improvement works have been done or to the additional area brought under irrigation. Clearly, the latter is a much more meaningful measure of impact, but no estimates are available. No attempt has been made to measure the characteristics of tank water supply and use (quantum, duration, seasonal pattern) before and after the improvement.

There are few ex-post evaluations of these schemes. One of the rare studies (done way back in the 1950s) found that repair and restoration works concentrated mainly on earthern embankments and repair of sluices. The equally important task of repairing inlet channels to restore their original capacity did not receive adequate attention. Experience with DCR schemes highlighted the limitation of desilting the tankbeds as a means of increasing effective capacity.

The problem arises basically from the large volume of silt to be excavated and disposed off. In the past, farmers used to regularly remove accumulated silt from the tank and spread it on their cultivated fields as a means of raising fertility. But the practice has gone out of vogue, perhaps because chemical fertilisers are a much cheaper source of nutrients: per unit of nutrient, manures take far more time and labour to prepare, transport and apply. In any case, farmers are known to be unwilling to have the silt deposited on their fields.

The DCR scheme attempted to use the silt to strengthen tank *bunds* and raise foreshore lands (the latter as a means of reducing flooding of these lands and incidentally reclaiming some land for cultivation). But the results have apparently not been encouraging enough to justify adoption of the technique widely. Some early evaluation studies (of the 1950s vintage) of DCR in Tamil Nadu suggest that the extent of foreshore land reclaimed is small, most of it being privately owned rather than uncultivated government land. That there has been so little interest in systematic study of technical (and economic) aspect of desiltation and exploring alternative ways of tackling it, points to serious weakness in planning.

The experience of the EEC tank modernisation programme, by far the most ambitious effort so far, brings out several lacunae into sharp relief. An independent monitoring of the programme (Anna University, 1989) highlights its key deficiencies.

(1) In the absence of comparable capacity measurement at an earlier point in time, the extent of reduction in capacity due to siltation cannot be assessed. The general impression was that the extent of siltation in the tanks studied was negligible.

(2) The estimates of water supply available in the tanks are subject to rather wide margins of error. There are substantial variations between inflow of water predicted on the basis of the empirical formula in vogue and actual inflows as measured. Systematic studies in more locations to permit analyses of the relation between actual and predicted inflows are needed.

(3) Revisions of formulae/parameters for estimating maximum flood discharge, which determines the decisions regarding re-design of surplus weirs, need to be reviewed to make sure that they are standardised on the basis of adequate observation and analysis. Measures to improve the condition of the channels carrying the surplus deserve as much attention as the re-design of the surplus weirs.

(4) Though the necessity for improvement of inlet channels is recognised, they are not always incorporated in the programme. Somewhat less than half the tanks studied had provision for this. Catchment area treatment tends to be totally neglected.

(5) The traditional plug type sluice arrangement is much better than screw-gauge type shutters for preventing leakages when the sluice is closed and for regulating the quantum of water flow when it is open.

(6) There are no measurements of seepage losses in different segments of the commands. And instead of lining on a selective basis, which was envisaged in the project, complete lining of up to 10 hectares blocks was done.

(7) The estimates of potential economy in water through lining and better water management are not based on any systematic observations. One would expect the potentials in this respect to vary between tanks, but the project assumed the same parameters of water saving both before and after modernisation of all tanks.

(8) While farmers generally welcome the lining of main and branch channels, there are problems in deciding what type of design and lining material is appropriate. Also farmers are resistant to changing alignments of field channels or traditional rules regarding water distribution.

(9) Farmers were informed rather than consulted about their perception of the problems in relation to their tank and its *ayacuts*, or their ideas regarding possible solutions. Farmers committees were not formed till the works were well under way; rotation schedules had not been worked out; and the responsibilities concerning maintenance of facilities created not clarified.

Following this evaluation there has been greater emphasis on consulting farmers in designs of schemes,

and encouraging them to establish formal organisations for collective management. How successful they have been remains to be assessed. There has been little improvement in monitoring works done, and their impact on irrigation quality and productivity.

The virtual absence of monitoring and evaluation mechanisms reflects more basic lacunae in planning and implementation of tank improvement programmes. Schemes are launched without a coherent overall strategy with reasoned and clearly spelt out priorities as between regions and different categories of tanks (system vs non-system, PWD vs *panchayat* union/ ex-*zamin* tanks). In terms of area affected, the PWD tanks are far more important than the others; the approaches appropriate to the different categories also differ. The bulk of the resources of the PWD seem to be spent on non-system and *panchayat* union/ex-*zamin* tanks. The choice of specific tanks does not seem to be determined on the basis of any well-defined and consistently applied criteria.

Schemes for tank improvement are conceived independently of other forms of irrigation. One would have thought that improvement of system tanks must be an integral part of modernisation of large surface systems of which they form part. Improvement of non-system tanks, irrespective of administrative jurisdiction (PWD or *panchayat* unions), are best conceived as part of integrated watershed development. Where possible supplies can be brought from outside the watersheds by linking them to larger systems. That integrated watershed development has a significant direct bearing on developing and improving tanks is recognisied but weakly. At present, the concept hardly informs planning of tank modernisation.

The lack of a coherent overall strategy is compounded by fragmentation of funding and programme implementation among different agencies. From the fragmentary information published in plan documents, a large number of repair and improvement of minor irrigation works is done under the Jawahar Rojgar Yojana (JRY) and the community development programmes. The Eighth Plan document indicates a target of 9,200 minor irrigation works and 6,250 percolation ponds under the JRY (the total number of tanks covered under the PWD is not even 300). If numbers are any indication the money spent outside the PWD must be quite large. But there seems to be little interest in making the potentially far more effective use of these resources from an integrated determination of the content and priorities for different agencies and close monitoring of all components.

Concern about cost-effectiveness of the programmes or their economic viability is conspicuously lacking. The fact that the average outlay per ha of area benefitted under tank modernisation are relatively high-ranging between Rs 10,950 and 17,200 per hectare (CWR, 1989) and differ substantially as between different programmes which does not seem to have attracted any notice, not to speak of critical scrutiny. Costs per hectare of area benefited are not particularly meaningful in the case of rehabilitation and improvement projects whose main purpose is to restore and, if possible, improve the quantum and reliability of irrigation supplies from degraded tanks. It is important to ask whether the works are technically necessary and whether the specifications and constructions are designed to achieve the desired results at least cost. There is no indication in the project documents that these issues are addressed seriously. Nor do the few available ex-post evaluations examine these aspects. One gets the impression that the package of works follows a set pattern instead of being tailored to the problems specific to each tank. The prevailing system of contracting such small dispersed works and supervising the implementation of the contracts is hardly conducive to ensuring that specifications are met and costs are kept to the minimum.

Benefit-cost ratios are no doubt computed. Schemes which do not meet the prescribed minimum are supposed to be rejected. However the basis for benefit estimates are extremely thin and fragile. For a proper assessment of benefits one needs to know the effect of the scheme on water availability and the impact of improved water supply on production in the *ayacut*. It is understandable that lack of necessary information makes informed judgements unavoidable. But one would expect that planners will have taken steps to collect necssary information and thereby improve the quality of benefit estimates. The fact however is that no effort has been made to build up such a database even after 50 years of tank rehabilitation. ■

Notes:

1. Very little is known about the areas under old Hyderabad state.

2. It could be that the 1980s were marked by unusually frequent and large droughts. This is certainly the case in Tamil Nadu. But this does not vitiate the point made here: The revenue department figures of tank irrigated area (net) in the 1970s are in general higher than in the 1980s, yet well below the PWD figures.

3. Apparently, this distinction is not followed in the areas which were made in the old princely states of Hyderabad and Mysore.

4. As per the PWD classification perennial system tanks and non- perennial system tanks are categorised as Class I tanks and Class II tanks respectively. All the non-system tanks are categorised into Class III and Class IV tanks as per the availability of supply in the tanks.

5. In normal supply years :
   Class I tanks supply water for three crop seasons (**9 - 12 months**);
   Class II tanks supply water for two crop seasons (**6 - 9 months**);
   Class III tanks supply is possible for 1-1.5 crop seasons (**3 - 6 months**); and
   Class IV tanks supply water for less than one crop season (**< 3 months**).
   For more details refer to GO No 250I, PWD, GOM, 03-06-1914.

Chapter 3

TANKS OF PERIYAR VAIGAI BASIN

K Sivasubramaniyan
A Vaidyanathan

The Periyar-Vaigai basin (PVB), situated in the southern part of Tamil Nadu, drains an area of 7,393 sq km spread over 13 talukas in the districts of Madurai, Dindigul, Pasumpon Muthuramalinga Thevar and Ramanathapuram *(Map 3.1)*. Both Periyar and Vaigai originate in the Western Ghats, join each other just upstream of the site of the present Vaigai dam, and flow eastward to empty into the Bay of Bengal near Ramanathapuram. The basin benefits from rainfall in both the monsoons, the northeast monsoon contributing about 45 per cent and the southwest about a third of the total precipitation. About a third of the basin

Map 3.1: Distribution of Taluks under the Periyar-Vaigai Basin

(2,634 sq km) falls in the hilly terrain and has a relatively higher rainfall than the lower part extending from the Vaigai dam to the sea.

The water resources of the basin are harnessed by two large reservoirs (Periyar and Vaigai dams), three diversion *anicuts* across the river downstream of Vaigai dam, some 4,200 tanks (about 600 of which are fed partly by canals drawn from the reservoirs and *anicuts*) and a large number of wells. The total irrigated area in the basin, estimated at 2,45,000 hectares, comprises about 40 per cent of cultivated area. Tanks account for nearly half the irrigated land, followed by wells (30 per cent) and direct canal irrigation about (20 per cent). About a fourth of the area under tank irrigation is served by system tanks. All the rest is served by rainfed non-system tanks.

Statistics of land use, irrigation and crop pattern of the taluks falling within the PVB are given in *Tables 3.1* and *3.2*. Some broad features may be noted:

(1) The proportion of cultivated area irrigated by one or other source is lower in the taluks situated in the head reach of the basin compared to those in the middle (below the Vaigai dam); this ratio falls again in the tail–reach segments reaching a low 18 per cent in Ramanathapuram taluk.

(2) Wells are the dominant source in the upper reaches, tanks are the dominant source in the tail-end taluks, and canals in the middle. In most taluks paddy is the main irrigated crop. But high value, long duration crops (sugarcane, banana, coconuts, horticultural crops) figure more prominently in the irrigated crop pattern of head and tail segment taluks, while paddy is predominant in the middle.

As mentioned earlier, most of the 4,200 tanks have *ayacuts* less than 40 hectares, except for some 400 system tanks, which are wholly managed by the *panchayats*. System tanks (of which there are some 600) and non-system tanks with *ayacuts* exceeding 40 hectares come under the purview of the PWD. The talukwise distribution of the PWD tanks in the PVB, indicating the number with *ayacuts* below 40 hectares and above 40 hectares as well as the total *ayacut* in each class, are given in *Table 3.3*.

Table 3.1: Talukwise Details of Area Covered Under PVB, 1981 (Area in hectares)

Sl No	Name of Taluk	Total Area	Cultivable area	% of cultivable area to total area	Irrigated area	% of Irrigated area to total cultivable area	Land Use Pattern							
							Forests	Area Irrigated by			Un-irrigated area	Cultivable waste	Area not available for cultivation	
								Tank	Well	Canal	River			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Uttamapalayam	96,178	59,342	61.7	18,218	30.7	25,534	1,203	13,597	3,411	0	39,828	1,295	11,310
2	Periyakulam	170,648	78,839	46.2	20,814	26.4	68,785	2,239	15,234	3,210	97	42,140	15,870	23,072
3	Nilakkottai	94175	54,716	58.1	24,896	45.5	19,458	10,323	6,810	7,678	77	23,802	5,975	19,052
4	Usilampatti	1,00,633	55,751	55.4	28,823	51.7	30,065	4,747	19,741	4,323	0	26,145	787	14,775
5	Madurai South	20,461	14,241	69.6	5,867	41.2	0	4,655	594	0	616	7,127	1,246	6,223
6	Madurai North	33,918	26,151	77.1	22,411	85.7	0	5,179	47	16,775	434	2,157	1,574	7,753
7	Melur	63,263	48,902	77.3	23,571	48.2	0	7,627	0	15,916	0	12,129	13,216	14,376
8	Tirumangalam	79,958	63,567	79.5	14,430	22.7	1,255	6,470	7,979	0	5	41,715	7,399	15,135
9	Sivaganga	1,12,023	74,719	66.7	26,899	36.0	5,422	18,590	8,339	0	0	39,873	7,909	31,890
10	Manamadurai	62,392	41,865	67.1	22,356	53.4	970	22,344	0	0	0	16,876	2,651	19,551
11	Ilaiyankudi	38,643	29,021	75.1	9,490	32.7	0	9,487	0	0	0	19,489	35	9,631
12	Paramakudi	72,695	58,883	81.0	17,194	29.2	47	17,097	38	36	0	38,753	2,952	13,771
13	Ramanathapuram	73,864	64,631	87.5	11,504	17.8	0	11,475	0	0	0	44,469	8,653	9,267
Total		**10,18,851**	**6,70,627**	**65.8**	**246,472**	**36.8**	**1,51,536**	**1,21,436**	**72,379**	**51,349**	**1,229**	**3,54,503**	**69,562**	**1,95,806**

Note: Totally there are 30 talukas in Madurai (13) and Ramnad (17) districts. However, only 13 talukas are fully or partly covered by the PVB, which are included in the table. Sl nos 4,8,9,10 and 11 are the talukas which cover only a part of the area under PVB. As per 1981 Census taluks under Sl nos 1 to 8 are in Madurai district and the remaining in Ramanathapuram district.

Source: Census of India, District Census Handbook, Series 20, Tamil Nadu, Part XIII-A, Village and Town Directory, Madurai and Ramanathapuram Districts, 1981.

Table 3.2: Area Under Crops (Irrigated) in the Taluks of Periyar-Vaigai Basin, 1988-89

(Area in hectares)

Sl No	Name of taluk	Paddy	Other cereals & pulsus	Veg, condiments & spices	Sugarcane	Banana	Coconut & orchards	Cotton	Total oilseeds	Others	Gross irrigated area (GIA)	Net irrigated area (NIA)	Gross cultivated area (GCA)	Net sown area (NSA)	Cropping intensity	% of paddy to GIA (3/12)	% of Col 6+7+8 to GIA
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1.	Uthamapalayam	12,225	5,720	993	358	1,904	3,826	4,702	4,667	2,293	36,688	27,056	71,651	61,057	117.4	33.3	16.6
2.	Periyakulam	9,275	2,165	1,434	2,672	580	1,812	1,471	2,404	6,542	24,013	21,122	46,465	27,720	167.6	38.6	21.1
3.	Nilakkottai	4273	88	28	751	390	1,270	217	186	2,580	9,783	8,716	22,925	22,075	103.9	43.7	24.6
4.	Usilampatti	8,847	3,250	213	413	53	250	3,150	3,099	734	20,009	17,335	43,791	41,186	106.3	44.2	3.6
5.	Madurai (S)	4,559	350	104	160	600	492	160	1,117	104	7,646	7,486	10,768	10,696	100.7	59.6	16.4
6.	Madurai (N)	32,075	206	31	694	103	245	3	41	46	33,444	22,121	34,731	23,411	148.4	95.9	3.1
7.	Melur	14,751	1,155	46	1,518	309	190	104	1,790	3,399	21,140	18,477	35,305	33,028	106.9	69.8	9.5
8.	Thirumangalam	6,933	1,437	464	213	77	188	1,350	2,054	145	12,861	10,846	52,569	51,904	101.3	53.9	3.7
9.	Sivaganga	13,782	256	136	1,412	110	145	15	766	175	16,797	10,723	19,823	19,764	100.3	82.1	9.9
10.	Manamadurai	5,606	325	75	3,184	155	1,047	189	21	323	10,925	10,729	13,078	13,052	100.2	51.3	40.1
11.	Ilyangudi	5,453	113	540	105	140	3	27	1	88	6,470	6,443	19,998	19,998	100.0	84.3	3.8
12.	Paramakudi	8,130	594	1,534	92	60	67	318	142	876	11,813	11,495	30,101	29,249	102.9	68.8	1.9
13.	Ramanthapuram	5,226	14	464	0	7	1,880	0	28	47	7,666	7,666	27,837	27,837	100.0	68.2	24.6
Total		**1,31,135**	**15,673**	**6,062**	**11,572**	**4,488**	**11,415**	**11,706**	**16,316**	**17,352**	**2,19,255**	**1,80,215**	**4,29,042**	**3,80,977**	**112.6**	**59.8**	**12.5**

Note: Other Cereals and Pulses: *Cholam, Cumbu,* Ragi, Bengal gram, Black gram, Red gram, Horse gram and others; Vegetables, Condiments and Spices: Chillies and Onion. Coconut and Orchards: Coconut, Tamarind; Total Oilseeds: Groundnut, Gingelly, Castor and Sunflower.

Source: G-Returns, Department of Statistics, Government of Tamil Nadu, Unpublished, 1989.

SCOPE AND DESIGN OF STUDY

For purposes of this study, which is limited to PWD tanks, seven taluks were selected: two each from the head and the middle segments of the basin which had sizeable number of both system and non-system tanks and three in the tail–reach, of which one had both types of tanks and two had only non-system tanks. The PWD tanks in these taluks were grouped into three size classes and from each category one tank was selected for the survey. On this basis 36 tanks were chosen — 15 system and 21 non-system tanks. The selection of specific tanks was guided by logistic conditions, especially accessibility by road and distance from the nearest town *(Table 3.4).*

A rapid survey of all tanks was conducted between October and December 1995, on the basis of a structured schedule, (Details on methodology adopted for the survey of tanks in both the Periyar-Vaigai and the Palar basins are outlined in Appendix 1). The PWD officials at Madurai, (the headquarters of the Periyar-Vaigai Basin) helped us to get the technical data on selected tanks. Their help in contacting the village officials greatly facilitated establishing contacts in the concerned villages, efficient scheduling of visits and securing cooperation of villagers.

The PWD section offices which control the individual tanks provided detailed information on the technical features of each tank, maps, repair and maintenance works taken up by the PWD in recent years and expenditures incurred on them. They also gave information on date of opening and closing of canals supplying the tank in previous three years starting from 1994-95. Local PWD official (*laskars* and work inspectors) helped us visit and get a first-hand information on the conditions of tank structures and problems related to them.

Data on registered *ayacuts,* wells in the *ayacuts,* crop patterns and the general tank-related matters were compiled from the registers maintained by village administrative officers. The village *thalaiyaries* and *thotties* have intimate first-hand knowledge of the operation and management of the tanks. Besides sharing this knowledge with us, they helped identify knowledgeable *ayacutdars* and leaders involved in tank management, and arranging for meetings with them.

Village leaders such as *ambalams, nattanmai,* irrigation functionaries (*neerkatti* and *madaiyan*) and other knowledgeable persons were interviewed to find out the present position of tanks, their functioning and

Table 3.3: Talukwise Distribution of System and Non-system Tanks under the Periyar-Vaigai Basin, 1991

(Area in hectares)

Sl No	Name of taluk	Name of system	System tanks						Non-system tanks					
			Tanks with *ayacut* < 40 hectares		Tanks with *ayacut* > 40 hectares		Total		Tanks with *ayacut* < 40 hectares		Tanks with *ayacut* > 40 hectares		Total	
			No	Area	No	Area	No	Area	No	Area	No	Area	No	Area
1.	Uthamapalayam	Periyar	20	384	22	2,621	42	3,005	0	0	0	0	0	0
2.	Periyakulam	—	0	0	0	0	0	0	0	0	15	1,598	15	1,598
3.	Nilakkotai	Periyar	4	118	16	3,252	20	3,370	5	100	11	1,379	16	1,479
4.	Thirumangalam	—	0	0	0	0	0	0	0	0	21	2,559	21	2,559
5.	Usilampatti	VRS	6	96	20	1,955	26	2,051	0	0	7	700	7	700
6.	Madurai	Periyar	78	2,051	86	7,910	164	9,962	0	0	25	6,856	25	6,856
7.	Melur	Periyar	105	2,350	54	5,312	159	7,662	0	0	5	545	5	545
8.	Melur	VRS	70	499	2	115	72	613	0	0	0	0	0	0
9.	Sivaganga	VRS	114	1,520	16	1,079	130	2,598	0	0	104	21,662	104	21,662
10.	Paramakudi	—	0	0	0	0	0	0	0	0	87	14,761	87	14,761
11.	Ramnad	—	0	0	0	0	0	0	0	0	30	6,560	30	6,560
	Total		**397**	**7,018**	**216**	**22,244**	**613**	**29,262**	**5**	**100**	**305**	**56,619**	**310**	**56,719**

Note: * Sivaganga includes Manamadurai and Ilaiyankudi taluks; — indicates non-system taluks under the PVB. As per 1991 Census, taluks under Sl nos 1,2,4 to 8 come under Madurai district; Sl no 3 is in Dindigul-Anna district; Sl no 9 in PMT district; and Sl nos 11 and 12 in Ramnad district.

Source: Taluk classification is based on Census of India 1991, Tamil Nadu. Classification of number of tanks and *ayacut* are taken from the Details of Tanks In-charge of Public Works Department, Office of Chief Engineer, PWD, Madras, 1977.

management as well as problems regarding maintenance of tank structures and the use of tank water.

In each selected tank we spent about two days to acquire all the details. This is thus in the nature of a rapid appraisal, which gives a broad overall picture of the conditions and working of the tanks. Detailed probing inquiries were not possible. In some cases this proved too short a period to collect all the information envisaged in the schedules. Some important items such as details of cropping pattern and number of wells within and outside the *ayacuts* were not always readily available. Re-checking of necessary information by revisits to the field and the PWD offices was also not possible due to lack of time.

CHARACTERISTICS OF SELECTED TANKS

The locations of selected tanks in the basin are shown in *Map 3.2*. Their main technical features are detailed in the annexure to this chapter *(Table A3.1–A3.2)*. *Table 3.5* presents a summary picture.

Six out of 15 *system tanks* are located in the head reach of the PVB. The first three tanks are served by branch canals 2 and 3 of the Periyar Main Canal (PMC) and the remaining three by Tirumangalam Main Canal (TMC, *see Map 3.2*). The six middle reach tanks are supplied by branch canals number 9 and 10 of PMC and two of the three tail-end tanks by the 12th branch canal of PMC. Only three tanks (one in head reach and two in middle reach) are multi-village tanks and the remaining are single village tanks. Except Poduvarpatti tank all others are multi-sluice tanks.

Two of the head reach tanks (Parali and Mannadimangalam), rated class II, are expected to receive supply for two crop seasons. The remaining four in the head reach and all six tanks in the middle reach are class IV tanks capable of supplying water for three months or less, that is, for a single season. The three tail-end tanks, rated class III, are expected to provide water for three to six months.

According to information provided by knowledgeable villagers, during the three years prior to the survey, class II head-reach system tanks began releasing water in June-July. First release of water in the other tanks in the head reach and those in the middle reach was spread between August and October (with a bunching in September). Tail-reach tanks release water much later: between October and January. Based on information given by villagers, the average duration of supplies

Table 3.4: Location of Selected Taluks and Tanks in the Periyar-Vaigai Basin

Reach	Taluk	Classification	Total tanks	Sample tanks (hectares)		
				40 – 100	101 – 200	200 +
Head	Nilakkotai	System	20	1	1	1
		Non-system	16	1	1	1
	Usilampatti	System	26	1	1	1
		Non-system	7	2	1	–
Middle	Madurai [North]	System	164	1	1	1
	[South]	Non-system	25	1	1	1
	Melur	System	159	1	1	1
		Non-system	5	2	1	–
Tail	Sivaganga	System	130	2	1	–
		Non-system	104	2	1	–
	Paramakudi	Non-system	87	1	1	1
	Ramanathapuram	Non-system	30	1	1	1
Total		**System**	**499**	**6**	**5**	**4**
		Non-system	**274**	**10**	**7**	**4**

Note: Dash indicates nil.
Source: GOTN., Details of Tanks in Charge of PWD, Office of the Chief Engineer, PWD, Madras, 1977.

to the *ayacut* was close to the rating in the two class II tanks, and better than rating in the class IV tanks (all of them situated in the head and middle). In the tail-end supplies were available for less than four months on the average, against the expected three to six months. Even this supply seems to have been largely from local catchment rainfall in as much as they did not receive any water from their supply channels.

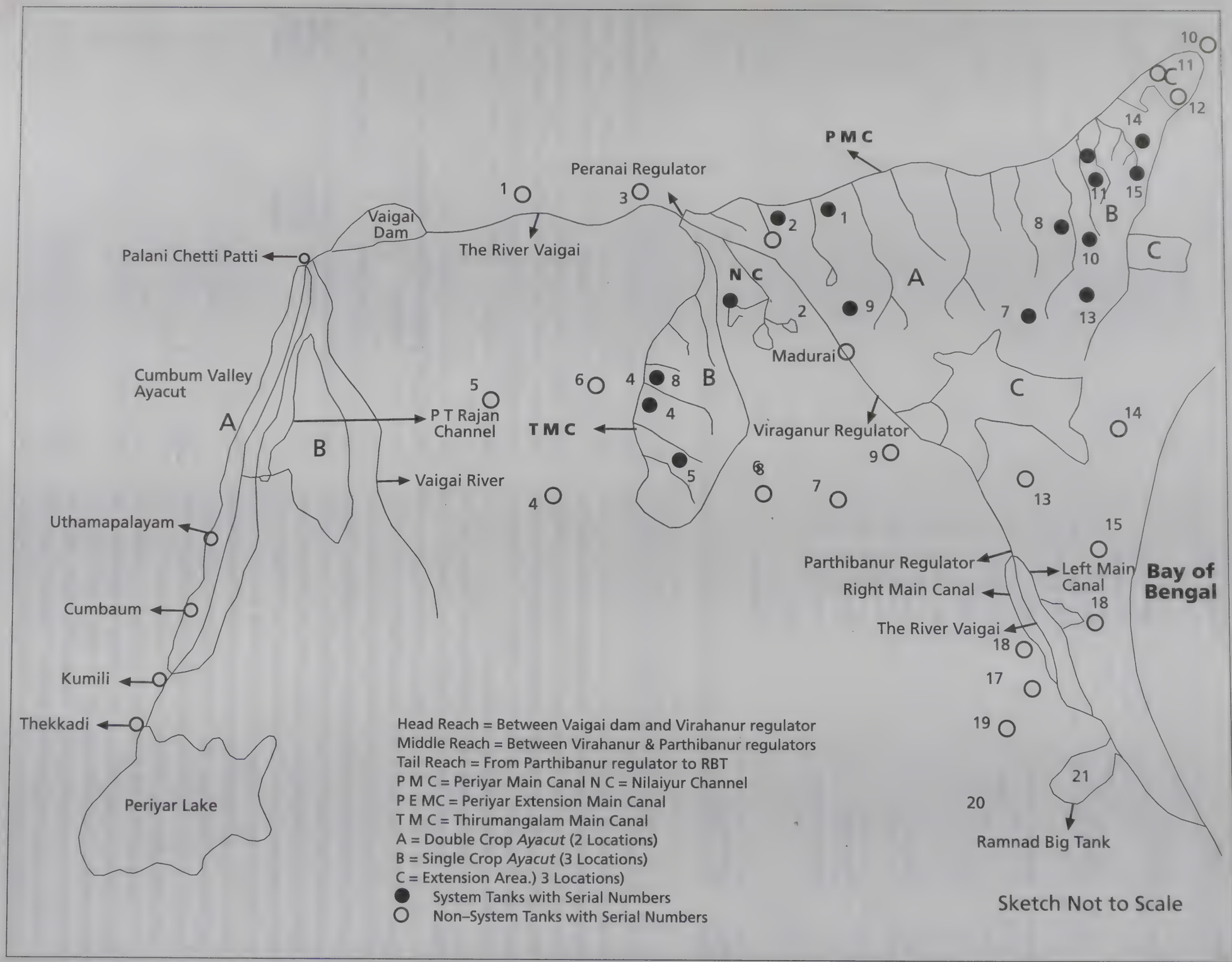
The storage capacity per hectare of *ayacut* is the highest in three of the head-reach tanks (Sl nos 4 to 6) served by the TMC and all the tail–reach tanks served by the PMC. The free catchment per hectare of *ayacut* is relatively more in all the three tail–reach tanks compared to head and middle-reaches. The relatively larger capacity of tail–reach tanks is probably designed to take advantage of larger free catchments and excess flows from upstream tanks. The head reach tanks (especially the tanks served by the PMC — Sl nos 1 to 3 — and all the middle reach tanks have less water spread area (WSA) per hectare of *ayacut*. As a consequence, the average depth of water stored is generally more in the middle reach tanks than in the head or tail–reach tanks.

Six each out of 21 selected non-system tanks are located in the head and middle-reaches of the basin; the remaining nine tanks are in the tail–reach. All the non-system tanks-except the Ramnad Big Tank (RBT) at the tail-end are single-village tanks. All but one (Landai) are multi-sluice tanks. There is not much difference between the head and middle reach tanks in terms of depth. The tail–reach tanks are relatively shallow (average depth ranging from 1.2 metres to 3.6 metres). They have a slightly larger capacity than the middle and head reach tanks, perhaps because of the larger free catchment area available for these tanks. Apparently the water spread area of all the tail–reach tanks are relatively larger than the head and middle reach tanks. There is no

Table 3.5: Salient Characteristics of Study Tanks

	System tanks				Non-system tanks		
Reach	Class	Number	Date of opening*	Average duration of supply (months)	Class	Number	Average duration of supply (months)**
Head	II	2	June-July	7.7	III	4	2.7
	IV	4	Aug-Oct	3.7	IV	2	2.4
Middle	IV	6	Aug-Oct*2	3.8	III	3	4.4
					IV	3	2.7
Tail	III	3	Oct-Jan	3.9	III	7	4.8
					IV	2	4.8

Note: * Relates to the period 1992-93 to 1994-95 as reported by villagers.
** Relates to 1994-95.
Source: Field Survey, 1995.



Map 3.2: Distribution of System and Non-system Tanks in the Periyar-Vaigai Basin

discernible difference in the capacity per hectare of *ayacut* across reaches.

The majority of selected non-system tanks (14 out of 21) belong to class III and the rest to class IV. The former are more numerous than the latter in the head and tail segments of the basin; they are in equal number in the mid-segment. As per villagers' information, head reach tanks are worst placed in terms of duration of supplies. (Information on dates of release was not available). They get water on the average for less than three months; tanks of the mid-reach are somewhat better placed. But it is the tail-end tanks which supply the water for the longest duration (average 4.8 months) with several reporting more than seven months. In fact even class IV tanks in this segment report supplying water for as long a duration as class III tanks. It is noteworthy that class IV system tanks report a longer duration of supply than their counterpart non-system tanks in the head and middle of the basin, while class III non-system tanks seem to do better than similar system tanks. The reasons for these differences cannot be identified without more detailed investigation than was possible in this study.

CONDITIONS OF PHYSICAL STRUCTURES

In seven out of the 15 system tanks the inlet channels are in good condition whereas in the remaining eight tanks they have been encroached upon and/or silted. The encroachment is severe in the head/tail–reach tanks.

- Only head reach tank *bunds* are in good condition. The *bunds* of almost all the middle and tail–reach tanks are depressed in many places or breached in some places.
- There is hardly any encroachment of tankbeds, for either cultivation or grazing, in all but one tank. Tankbed siltation is everywhere reported to be considerable. The intensity of reported siltation being more in the middle reach tanks than in the head and tail-reaches *(see Annexure Table A3.3)*.
- Sluices and control structures are in good condition in the head reach tanks, but damaged in most of the tail/middle reach tanks. In two of the tanks — one each in the head and middle-reaches — shutters to control water flow from the sluices are reportedly not available.
- Surplus weirs in all the middle reach tanks are in good condition; they are weak or damaged in some tanks in both the head and the tail reaches.

Among non-system tanks three are surrounded by hills and water is drawn directly from the catchment without any well-defined inlet channel. *(For tank specific details see Annexure Table A3.4)*. All others have inlet channels and most of them are not in good condition. Whereas in nine tanks the channels are both encroached upon and silted heavily, the rest are either heavily silted or encroached upon. This is mainly due to poor maintenance of the channels. Farmers reported that they undertook maintenance whenever necessary, but evidently this is not adequate.

- In most of the tanks (except three in the head reach) the tank *bunds* are either breached or heavily depressed in many places. This is more evident in the tail–reach tanks than in the head and middle-reaches.
- Siltation of tankbed is reported by most tanks. Practically all tail–reach tanks are said to be heavily silted. A majority of the head and middle reach tanks report little or no siltation.
- Encroachment of tankbeds in middle reach tanks is not a serious problem. In one of the tanks (Pudukulam) an active irrigation board (IB) has addressed the problem vigorously and succeeded in getting the concerned officials to take steps to remove the encroachment. By contrast, in Semini Kanmoi, where the encroachment is less severe, nothing has been done about encroachment because of lack of interest among the *ayacutdars*.
- Out of 21 tanks only three reported that sluices and control structures are in good condition. About half of the selected tanks do not have proper shutters to regulate the available supply. In two-thirds of the selected tanks, all the available sluices are reported to be in damaged condition.
- Surplus weirs are in good condition in most tail–reach tanks. They are either weak or breached in most head and middle reach tanks. In a couple of tanks, all the available surplus weirs are badly breached thereby substantially reducing storage capacity.

In order to compare the conditions of physical structures of different tanks we have used a scoring system in respect of different structures taken individually and in combination. This shows that there are marked differences in the conditions of physical structures in the system and non-system tanks: In general physical structures are relatively better in the system tanks than in the non-system tanks. Among system tanks the head reach tanks are better placed followed by middle and tail–reach tanks. However, there is no marked difference across reaches in the conditions of structures of non-system tanks *(Table 3.6)*.

Table 3.6: Comparative Performance (in terms of average score) of Tank Structures Across Reaches

Tank structures	Maximum score	System tanks (average score)			Non-system tanks (average score)		
		HR	MR	TR	HR	MR	TR
Inlet channels	2	1.3	1.3	1.3	0.5*	0.5	0.6*
Tank *bunds*	2	1.3	0.5	0.3	1.0	0.3	0.2
Tankbeds	1	0.7	0.2	0.7	0.5	0.7	0.1
Sluices and control structures	2	1.3	0.5	0.7	0.3	0.7	0.6
Surplus weirs	2	1.0	2.0	0.7	0.5	0.7	1.3
Overall score	1.80	1.13	0.90	0.73	0.57	0.56	0.53

Note: For details on the method adopted for arriving at the scores see Appendix 2; * Excluding the tanks which do not have inlet channels.
HR = Head-reach; MR = Middle-reach; TR = Tail-reach.
Source: Survey, 1995.

WATER SUPPLY CONDITIONS IN THE SELECTED TANKS

Supply Conditions During 1992-93 — 1994-95

Besides run-off from their catchments, the selected system tanks (as can be seen from *Annexure Table A3.5)* are fed directly from one of the two main canals or more typically from one of their several branch canals according to schedules determined by the PWD. We could not get the precise schedule of delivery to the selected tanks and the rules on which they are based. However, on the basis of information obtained from villagers, we get the following picture of the actual water supply to various tanks.

(1) Two (Parali and Mannadimangalam) tanks get the supply during night time only (6 pm to 6 am). Quantity released on every day is restricted.

(2) Some tanks are supplied by weekly turns at specified times (usually 6 pm to 6 am) for a couple of days.

(3) Most of the tail–reach tanks (including Alavakottai and Namanur) get supply occasionally and that too if the *ayacutdars* make requests to the PWD. Their main source of supply, according to *ayacutdars,* is the catchment run-off. Only when the catchment supply is inadequate do farmers request for canal water. Mostly the tail–reach tanks receive canal supply for a fortnight.

(4) One of the tail–reach tanks (Mudikandam) has not received the PMC supply so far due to non-formation of branch channel to supply water to the tank. Its supply is determined wholly by the catchment run-off.

The PWD records contain information on dates of opening and closure of canals supplying water to several, but not all, of the selected tanks. Also they do not indicate the number of days for which water is actually released to the tank and whether the given supply is continuous or intermittent. Nevertheless, the data give us a rough idea of the duration for which different tanks could have got supplies from Periyar-Vaigai Canal (PVC) system.

In 1994-95, the supply channels serving all head reach tanks were open for four or more months; in the two class II tanks that was open for seven to eight months. At the tail-end, the channel feeding one tank is not yet operational, while in two cases they were open only for 15 days. The duration for which the channels were open varies from year to year. There are persistent differences between head and tail-reaches in all the years. The system channels of course account only for a part of the supply to the tank and the rest comes from the free catchment run-off.

Knowledgeable farmers in each of the selected villages were also asked about the number of months for which the tank supplied water to the *ayacut* during three years preceding the survey. Based on their responses it appears that while some of the head reach tanks were far better placed than others (three of them reported supply for five months or more), the differences are much less than differences in reported duration of PVB supplies. Thus the tail-end tanks, which get only 2 weeks supply from PVC, could supply water for 3-4 months. This is largely a reflection of the differences in the relative contribution of catchment run-off and the system supplies. Tail-end tanks, as noted earlier, have the benefit of a larger free catchment and a larger capacity per unit of *ayacut* compared to head reach tanks. It is also noteworthy that, according to local experience, the available water supply in most of the tanks did not vary much between the three years. Two of the head reach tanks could supply water for two crop seasons in all

years. In all others water was available for one crop season in all three years.

The only source of supply to non-system tanks is their catchment run-off *(Table A3.6)*. Depending as they do solely on local rainfall, which is highly variable and on limited catchment area, the supplies are limited and liable to large year-to-year variations. It needs noting however that as many as 7 of these tanks have since been linked to the PVB under the scheme to extend the system command.

In 1994-95 — a relatively good year — water available in about half the head and the middle reach tanks reported to be inadequate even for 3 months; some did not get even one month supply. However, a majority of the tanks (14 out of 21) report that supply was sufficient to serve the ayacut for 4 months or more. Storage measured in terms of months of irrigation supply was relatively better in the tail–reach tanks compared to the middle and head reaches. Six out of nine of them had supplies adequate for 5 months or more.

The picture in 1993-94, as reported by farmers,is broadly similar but in 1992-93 — a year of rather poor rainfall — nearly half of the tanks could supply only for 3 months or less. Again tail-end tanks did much better, in fact nearly as well as in the previous year. Again this is probably because of their larger capacity and the fact that they have a larger free catchment per acre of *ayacut*. Some of them also benefit from becoming part of the extended PVB system.

CONJUNCTIVE USE OF GROUNDWATER

There are wells in the *ayacuts* of practically all system and non-system tanks. The well density (no of wells per 100 hectares of *ayacuts*) however varies from less than two to over 75 in the system tanks *(see Table 3.7)*.

The density is generally the lowest in the middle reach followed by the tail–reach tanks, and highest in some of the head reach tanks. In terms of the proportion of *ayacut* area benefiting from irrigation, the picture is broadly similar: It is relatively high in the head reach (more than 40 per cent in two cases) and in two tail-end tanks (about 25 per cent). With one exception, the incidence of conjunctive use is relatively small in the middle reach. The very high proportion of *ayacut* using well water in Thenur Periya Kye is accounted by its unusually abundant supply of groundwater due to proximity to the Vaigai river.

The frequency distribution of well density in non-system tanks is broadly similar to that in system tanks. But the proportion of area benefiting from well water is higher in the latter type tanks than the former

Table 3.7: Density of Wells and Use of Well Water in the Periyar-Vaigai System Tanks, 1995.

(*Ayacut* in hectares)

Sl No	Name of tank	*Ayacut*	No of wells in the *ayacut*	Well/ 100 hectares	Well water use in the *ayacut*	
					Total area	% to total
Head reach						
1.	Parali	80.1	9	11.2	5.5	6.8
2.	Thiruvalavayanallur	150.4	15	10.0	60.7	40.4
3.	Mannadimangalam	210.5	20	9.5	40.5	19.2
4.	Kuravakudi	64.1	20	31.2	8.1	12.6
5.	Ariyapatti	105.3	79	75.1	56.7	53.8
6.	Poduvarpatti	22.0	14	63.7	6.1	27.6
Middle reach						
7.	Rajagambiram	40.9	2	4.9	2.4	5.9
8.	Pottapanaiyur	52.7	1	1.9	1.2	2.3
9.	Thenur Periya Kye	274.1	80	29.2	161.9	59.1
10.	Perungalakudi	68.4	3	4.4	0.0	0.0
11.	Punjuti	183.4	32	17.4	18.2	9.9
12.	Maruthur	392.6	14	3.6	4.0	1.0
tail-reach						
13.	Mudikandom	152.5	17	11.1	8.9	5.8
14.	Alavakottai	114.7	26	22.7	27.5	24.0
15.	Namanur	175.5	40	22.8	48.6	27.7
	Total	**2,087.2**	**372**	**17.8**	**450.3**	**21.6**

Note: Total area receiving well water is based on the interviews held with the VAOs and local knowledgeable farmers who own wells in the *ayacut*. The figures are only approximate.
Source: VAO records of respective tanks.

(see Table 3.8). Six out of 15 system tanks report 20 per cent or more of their *ayacut* using wells compared to three out of 21 in non-system tanks. The pattern of variation across reaches is also different.

Though there are considerable variations within each segment of the basin, the proportion of *ayacut* using well water tends to decline progressively as we move from the head to the tail–reach. The extent of conjunctive use in the non-system tanks declines progressively and in a more pronounced manner from the head to the tail–reach of the basin. Since well densities in the two categories of tanks do not differ markedly, the relatively high incidence of conjunctive use in system tanks suggests that yield of wells in their commands is more than under non-system tanks. This is mostly due to better rechargeability of wells through the PVC system. *(see Table 3.8)*.

Table 3.8: Density of Wells and Use of Well Water in the Periyar-Vaigai Non-System Tanks, 1995

(*Ayacut* in hectares)

Sl No	Name of tank	*Ayacut*	No of wells in the *ayacut*	Well/ 100 hectares	Well water use in the *ayacut*	
					Total area	% to total
Head-reach						
1.	Kunnuvarayankottai	77.8	13	16.7	12.1	15.6
2.	Melakkal kye	158.2	20	12.6	15.4	9.7
3.	Ettilodu	121.8	27	22.2	18.2	15.0
4.	Kudiseri	91.5	55	60.1	15.4	16.8
5.	Elumalai	102.2	150	146.8	34.4	33.7
6.	Mudalaikulam (E)	125.8	114	90.6	81.0	64.4
Middle-reach						
7.	Perungudi (E)	93.3	9	9.6	6.1	6.5
8.	Othai Alankulam	103.2	30	29.1	12.1	11.8
9.	Panaiyur	259.1	26	10.0	10.1	3.9
10.	Vannariruppukanmoi	88.9	27	30.4	17.0	19.1
11.	Pudukulam (E)	93.5	13	13.9	10.5	11.3
12.	Semini kye (E)	130.4	6	4.6	12.1	9.3
Tail-reach						
13.	Okkur	86.1	25	29.0	20.2	23.5
14.	Nariyankudi	102.5	6	5.9	6.1	5.9
15.	Usilankulam	115.4	4	3.5	3.2	2.8
16.	Ariyakottai	83.5	7	8.4	8.5	10.2
17.	Urappuli (E)	194.1	5	2.6	6.1	3.1
18.	Kattuparamakudi (E)	179.7	5	2.8	4.0	2.3
19.	Landai	106.2	8	7.5	3.2	3.1
20.	Kooriyur	190.7	1	0.5	0.8	0.4
21.	Ramnad Big Tank (E)	1630.4	28	1.7	26.3	1.6
	Total	**4,134.3**	**579**	**14.0**	**322.8**	**7.8**

Note: Total area receiving well water is based on the interviews held with the VAOs and local knowledgeable farmers who own wells in the *ayacut*. The figures are only approximate; E = Extended system.

Source: VAO records of respective tanks.

IRRIGATION INSTITUTIONS

Management of the Periyar-Vaigai System

With the construction of the Periyar and the Vaigai dams, a number of tanks which were fed by local diversion of flows in the main river and numerous small streams were integrated into the Periyar-Vaigai system. The PWD has the responsibility for maintenance of the dam, main and branch canals of the system as well as the inlet channels and physical structures of all the system tanks (irrespective of size) and non-system tanks with *ayacut* more than 40 hectares. The PWD is also responsible for regulating the supply of water through main and branch canals and distributaries in different segments both for direct irrigation and for feeding the system tanks.

The system level operations are governed by formal rules and regulations whose main features as per the latest (1984) compendium are as follows:

- The Periyar lake will be under the control of the Executive Engineer (EE) of the PWD, Periyar-Vaigai division, Madurai. The control of the gate at Thekkady through which water is drawn from the Periyar lake shall however vest with the Tamil Nadu Electricity Board.
- During the irrigation season, the EE, Periyar-Vaigai division shall draw from the Periyar lake quantities required for irrigation taking into consideration the storage available in the Vaigai reservoir, the supplementation needed to meet the requirements of Cumbum valley *ayacuts* under PMC, the TMC, the quantity required for the Madurai Municipality and also the power requirements.
- The issues for power between 1st March and 31st May shall be suitably adjusted so as to maintain a minimum storage of about 1202 MCFT in the Periyar lake on 1st June.
- The Vaigai reservoir and its regulation shall be under the control of EE, Periyar-Vaigai division, Madurai.
- Ordinarily only the water from the Periyar lake shall be impounded in the Vaigai Reservoir.
- The Vaigai credit in the Vaigai reservoir at the end of the irrigation season will be utilised to fill up the Vaigai fed tanks and the balance of Vaigai credit, if any, can alone be allowed to be carried over to the next irrigation season.
- The Municipality of Madurai demand shall not exceed 600 MCFT in any year.
- The Vaigai reservoir shall not be depleted below the level of plus 865 since the small storage available below this level will be required for water supply to Vaigai colony, gardens, etc.
- While issuing water from the Vaigai reservoir, care should be taken to see that the water level of the reservoir is not depleted by more than two feet per day.
- Supply to the new short crop under Thirumangalam canal and long crop under new PMC will not be given if the combined effective storage in the Periyar lake, Vaigai reservoir and

the tanks in the Periyar command area is below 5000 MCFT at the beginning of the respective seasons, i.e., on 1st June and 15th September.

- If the combined effective storage of Periyar lake, Vaigai reservoir and tanks fall below 5000 MCFT at the beginning of the long crop season, a 25 per cent cut in the issues to long crop *ayacut* in the existing Periyar delta will be given effect to.

Supply of water to individual tanks is also supposed to be regulated according to certain rules and conventions. But these are not codified. The practices in respect of selected tanks will be detailed later in this chapter.

The PVB irrigation system, including the tanks, at present is controlled by 22 section offices (including main offices) from the Periyar dam to the Ramnad Big Tank, located in four districts of Madurai, Dindigul-Anna, Pasumpon Muthuramalinga Thevar (PMT), and Ramanathapuram. Madurai (the headquarters of the PVB) and Dindigul-Anna districts come under the head reach, PMT in the middle reach and Ramnad in the tail–reach of the basin.

The top management of the PWD in the region where the PVB is located consists of a chief engineer stationed at Madurai, three superintending engineers and six executive engineers. The head of the section office is usually the section officer/junior engineer/assistant engineer. During irrigation season his prime duty is to provide required quantum of water as per the availability from the PMC to the direct canal command as well as for the tanks under his jurisdiction. His other duties are to inspect the length of canals in his charge once a fortnight and every tank once a month, and prepare estimates for repairs and other works which may be necessary in his jurisdiction. The section officers are assisted by work inspectors in regulating canal water distribution, preparing estimates and supervision of works. These inspectors generally serve in the same section for long spells and have more first hand knowledge about local conditions. Therefore, they constitute a key part of the irrrigation bureaucracy.

The *lascars*/irrigation assistants are the field-level workers who actually undertake all the duties as directed by the junior engineer (JE)/work inspectors (WIs). They regulate water in the canal system irrigation command. Their main functions are to assist the WIs in all their duties. They have to maintain the canal networks and tank *bunds* by clearing the bushes and unwanted growth; clean and oil the sluices and shutters to keep them in good working condition; perform duties (such as closing or opening the sluices to supply water to the branch canals and inlet channels of the tanks and to the *ayacut* of major tanks during the tank supply season) assigned by the junior engineer; and maintain the records of daily canal flows and tank water levels and the rainfall readings properly. Sometimes they need to supervise the construction works such as *bund* maintenance, bridge construction, and masonry works undertaken by the contractors.

It was reported by the PWD officials that the general functioning of the section offices is not satisfactory. This is for at least two reasons: (i) the funds allotted for repair works are far from adequate, and (ii) the available staff (in 1995) is not enough to oversee the system. In most of the section offices, the vacancies caused by retirement, death, transfer, or promotion have not been filled. The most deficient staff category is of *lascars*/irrigation assistants who play a critical role in managing the system at the village level. At present (1995) the number of persons employed in this category in the system as a whole is reported to be barely two-thirds of the sanctioned strength.

Tenure of Staff

Generally, all the staff working in different categories are transferable. However the "tenure of stay in a section before transfer" varies among different categories. For instance, the JE/AE/SO is supposed to be transferred once in three years though in some cases transfer may be effected on personal and medical grounds even before the tenure period. For work inspectors and *lascars*/irrigation assistants, transfers are not compulsory. In some sections it was reported that the WIs have been working for many years in the same section office and have not been transferred except on personal request.

Tank-Level Organisation

Most tanks (both system and non-system), surveyed are single village tanks and are managed by informal institutions of the local community. Formal organisations at the tank level exist only in five of the 36 tanks surveyed: namely, Ramnad Big Tank (RBT), Kunnuvarayankottai; Mudalaikulam; Pudukulam; and Nariyankudi. All of these are non-system tanks and their formal organisations are of recent origin having been created after 1990 reportedly on the farmers initiative and registered under the Societies Act.

According to the secretary of the present RBT board, with the commissioning of the Vaigai dam in 1958, a part of the increased supplies were earmarked for the pre-existing *ayacuts*, including "indirect" *ayacuts* served by the system tanks. RBT benefited from this. But in the 1980s severe scarcity was experienced due to several factors: reduction of the storage level in the Periyar dam for major repairs to strengthen the dam and make it safer; reduced inflows at Vaigai dam due to an unusually high frequency of years with below normal rainfall; and excavation of sand from the

riverbed near Madurai. The effect of scarcity was particulalry acute in RBT situated at the very end of the basin. This is said to have triggered the formation of registered society. The factors which led to the constitution of formal organisations of the other tanks could not be ascertained. Nor the reasons why the initiative was confined to these four tanks.

The RBT being a large multi-village tank, the PWD is directly involved in the tank operation. To look after the tank level operations three *lascars* (irrigation workers) are appointed and paid by the government. These *lascars* are responsible for maintenance of the tank *bund* and associated structures and release of water. Water releases are made in consultation with the Ramnad Big Tank Farmers Organisation.

The RBT *ayacut* is spread over four revenue villages which have altogether 13 hamlets. Each hamlet nominates one representative (either the president or the secretary of the local village/hamlet organisation) to the RBT Farmers Organisation. They in turn elect the president, vice-president, secretary, joint secretary and Treasurer who constitute the executive committee of the tank level organisation. It has to meet once a month during the supply season and once in four months during the non-supply season. Normally, two meetings are held during the latter period but 3-4 during the former. tank-related matters (including augmentation of supplies to the tank) are considered and decided at these meetings. It deals directly with the PWD to resolve tank-related problems. Most of the problems at the village/hamlet level are settled by their representatives of local community organisation with the occasional intervention of tank organisation.

The major source of funds for the tank level organisation is the compulsory contribution of Rs 2,000/per hamlet. Apart from this, donations are collected from the prominent *ayacutdars* as well as town people. One important aspect of the representation is the equal weightage to caste leadership and membership among the hamlet villages. That is among 13 hamlet villages, seven representatives are elected from Scheduled Caste Pallars. During the second term of executive committee election held during 1994 one prominent Pallar was elected President of the RBT Farmers Organisation. Election is to be conducted once in three years. All positions, including executive committee membership, are honorary.

The main functions of the RBT Farmers Organisations and the other formal Farmers Association are to: (i) enforce the rules and regulations to maintain and distribute water during normal and lean supply periods; (ii) solve major problems in the system collectively; (iii) hold meetings with all the representatives once a month during irrigation season to discuss the irrigation matters and other activities; and (iv) distribute the tank supply fairly among the *ayacutdars* located in different reaches of the villages. The RBT Farmers Organisation also helps in augmenting water flow to the tank from the Vaigai dam, especially in the years when the monsoon fails.

One of the important functions of tank level organisation in RBT is to release the required amount of water from the tank to the *ayacut* villages. For this an oral request is made by the representative of the particular village to the secretary of the Irrigation Farmers Organisation stating the amount of water (in terms of sluice screws to be raised or lowered) to be released in the channel. This request is obliged by both the secretary of the Tank Organisation and the junior engineer of the PWD.

The size composition and mode of appointment of functionaries of the four other registered tank boards are given in *Table 3.9*.

All other selected tanks are managed by informal organisations of the user communities. Their main duties include: (i) inlet channel maintenance and efforts to bring more water to their tanks; (ii) repair and maintenance of all tank structures, including main/branch channels; (iii) representations to the PWD and to the influential political leaders to solve problems related to tank water supply, encroachments, repair and maintenance of tank structures, etc; (iv) appointing irrigation

Table 3.9: Composition of Formal Irrigation Boards Under Four Non-System Tanks

Name of tank	Year of establishment	Number of members		Membership fee (Rs/year)	Members position paid/honorary	Frequency of EC members election (years)	Meeting to be held once in months	
		EC	GB				EC	GB
Kunnuvarayankottai	1990	8	77	20	600*	3	4	6
Mudalai-	1992	3	50	15	Honorary	3	6	6
kulam Pudukulam	1995	13	150	40	Honorary	3	4	6
Nariyankudi	1995	4	64	25	Honorary	3	4	6

Note: * Indicates that the accountant only is paid Rs 600 per annum; EC = Executive Council; GB = General Body.
Source: Interviews held with the president/secretary of respective boards, 1995.

workers to manage tank water efficiently especially during scarcity periods; only two tanks(including RBT) where government appointed *neerkatties* to manage the irrigation supply; (v) eviction of encroachments in the tankbeds, channels and other common areas of the tank.

Village-level Organisation

All the selected system tanks, and a majority of non-system tanks, have informal village-level organisations to take care of tank-related activities such as organising the *ayacutdars* for maintenance of the channels; ensuring that sufficient water gets diverted through the inlet channels and that this water reaches the tank; and allocating water among the *ayacutdars* both during normal and lean supply periods.

None of the selected villages have any specialised personnel (like *kavaimaniyam* in North Arcot district) to supervise tank management. This task is vested with the village elders (called *ambalams/nattanmais*) who are responsible for overall management of the village affairs, including tank-related matters, organising festivals and settling disputes in the village. They are invariably drawn from leading land owners of the dominant caste in the village. Both are hereditary and honorary positions. But in some villages they have been appointed by the villagers from the kin groups of earlier *ambalam/nattanmai*. This is mainly due to changes in the power relations among them. In some of the non-system tank villages, where scheduled castes are the dominant land-owning group, *nattanmaikars* are selected from among the SCs *(Table 3.10)*.

In the case of system tanks the *ambalam/ Nattanmai* usually calls a meeting of *ayacutdars* in their village as soon as the tank starts receiving supply. The meeting decides when to start maintenance work of inlet and distribution channels and the contribution expected from each *ayacutdar* in the village. The *nattanmaikars* are responsible for supervising the organisation of these activities. Some, but only some, of them maintain good records of the contributions due from, and actually made by different *ayacutdars* for the maintenance work. They are also responsible for deciding, on the basis of convention, rationing of water supply to each farmer in times of scarcity, supervising the observance of rationing procedures, and arbitration of disputes, if any, over sharing water.

In most of the tanks the *ambalam/nattanmai* is assisted by local level irrigation workers. Some (called *neerkatties* and *madaiyans*) are specifically engaged for tank-related activities. The main duties of *neerkatties* are to irrigate the entire *ayacut* both in normal and scarcity supply periods in some tanks, while in some other tanks they are required to distribute water only during deficit period. *Madaiyans* are expected to operate the tank sluices and divert water to main *madais* from the channel as per the advice of village organisation. In most villages they have also to measure grains for each farmer during harvest period.

Thotties and *kavals*, who are appointed to perform a variety of functions for the village community (making public announcements, helping in village festivals, serving as village messengers and watchmen) are also used in several villages to perform irrigation related works. They are usually expected to mobilise the *ayacutdars* for channel maintenance, take care of petty irrigation works and supervise the channels to prevent illegal tapping and misuse of water by the upstream farmers.

The large majority of system tanks (12 out of 15) report having one or other of these functionaries: About half of these use only *thotties* or *kaval*; three employ *madaiyan/neerkatties*; and three have both. One village

Table 3.10: Composition of Village-level Organisation, 1995

Personnel	Caste composition of the personnel																					
Supervisory Level	System tanks											Non-system tanks										
	T/K/M	Muslim	Pillai	Naidu	Konar	Chetti	Others	Parayar	pallar	Chakkili	Dobi	T/K/M	Muslim	Pillai	Naidu	Konar	Chetti	Others	Parayar	pallar	Chakkili	Dobi
Ambalam/ Nattanmai	5	1	2	1	2	10	0	0	0	0		8	1	3	0	3	1	3	0	3	0	0
Lower Level																						
Lascar	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	3	0	0
Neerkatti	2	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	1	3	13	1	0
Madaiyan	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	1	1	6	1	0
Thotti	0	0	0	0	0	0	0	11	0	2	0	0	0	0	0	0	0	0	5	0	4	0
Kaval	1	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	5	4	1	0	0

Note: T/K/M = Thevar, Kallar, Maravar (Mukkulathor); Others: Nadar, Valayar, Servai, Brahmin, Mooppanar, Mutharayar.
Source: Village-level survey, 1995.

has a full-time government employee (*lascar*) to attend to these tanks. Employment of *madaiyan/neerkatties* is more in evidence in the case of relatively large-sized tanks; but there is no clear relation between tank size and number of functionaries *(Table A3.7)*.

Three of the head reach tanks do not have any lower level irrigation functionaries. They are all fed by the TMC which draw water from the Peranai regulator. During irrigation period all irrigation works are done by the *ayacutdars* themselves. The farmers in these three villages mostly belong to Mukkulathor (Thevar, Maravar and Kallar) community. Some knowledgeable people, including PWD officials in the area, report that before commencement of the TMC irrigation (in the late 1950s), the *ayacut* under these tanks was exclusively under rainfed cultivation and the yield was very poor and unstable. After commencement of the TMC irrigation, changes have been taking place slowly. But no structured organisation has developed yet. However, irrigation is fully controlled by *ayacutdars* themselves and no functionary has been appointed to help in this task.

Among non-system tanks *(Table A3.8)*, the proportion without any functionaries is much smaller compared to system tanks; and a much higher proportion employ *neerkatties* and *madaiyans*, often along with *thotties* and *kaval*. This suggests that tank-related activities command greater attention in the non-system tanks. This tendency is however much more in evidence among head reach and tail–reach tanks than in the middle. But there is no clear relation between number of functionaries on the one hand and reach or *ayacut* size on the other.

SELECTION AND REMUNERATION

In most villages the *ambalam/nattanmaikars* are hereditary positions, most have held the position for many years and some for life time. In most system tanks and in a majority of non-system tanks the non-SC members predominate the supervisory level. By and large, the Mukkulathor, Pillai and Konar predominate the supervisory category even as the SCs dominate the lower category. Mostly SC members operate the lower levels. However, in a couple of tanks, members of the Mukkulathor, Nadar, Valayar castes are appointed as *neerkatties/madaiyans*. So long as the villagers are satisfied, they can continue. The *neerkatties/madaiyan/thotti* are mostly selected on hereditary basis from among the Scheduled Caste households. Usually they are selected by rotation from among specified kin groups every year. However, in some cases *neerkatties/kaval* are temporarily selected by the *ayacutdars* for a specific period of one or two months during the irrigation period. Much the same practice is prevalent in non-system tanks as well, except for tail-end tanks where lower level functionaries are appointed on a temporary basis.

While the *ambalam/nattanmaikars* are honorary positions, the lower level workers are paid in kind by the farmers in most of the tanks/villages. The rate and form of remuneration however varies. In system tanks the majority of head and middle reach tanks/ villages pay in kind; and three middle reach tanks pay in cash. In all the tail-end tanks, the functionaries are appointed temporarily by the *ayacutdars* for one or two months during the final stages of the tank supply period and paid cash remuneration. Generally, *thotti/kaval* in a village get half the wages as given to *neerkatti/madaiyan*.

In all the tanks payments are made only for the tank supply period. If no crop is raised or if the crop fails (due to pest attack or other natural calamities) no payments are made for irrigation work. (However, *thotties* are always paid for performing village level duties). Payments are made irrespective of whether the *ayacutdars* raise paddy or other annual crops. For annual crops, such as banana or sugarcane, they get the remuneration equivalent to the entitlement in the case of paddy. This is locally called *sudanthiram* (compulsory payments made to irrigation workers). The development of well irrigation has not affected the functioning of this system. Even when well water is used for irrigating crops, including annual crops, the *ayacutdar* is expected to remunerate irrigation workers on the basis of rates applicable to paddy.

MAINTENANCE OF THE SYSTEMS

Maintenance of tanks involves two major tasks: (1) keeping the inlet channel and the physical structures associated with the tank (*bunds*, sluices and surplus weirs) in good repair; and (2) cleaning and desilting of the distribution channels within the *ayacut*. Formally the former is the responsibility of the PWD, which is supposed to ensure that all the inlet channels are cleaned of silt and weeds to ensure smooth inflow of water according to design capacity; construct retaining walls in the inlet channels where necessary; close breaches and strengthen tank *bunds*; attend to repair/replacement of damaged sluices; and desilt of tankbeds. Repair and maintenance of the distribution network is to be taken care of by the *ayacutdars* themselves. Our survey gives some idea of the extent and manner in which these tasks are in fact carried out. We elicited information on maintenance and repair works done during the five year period from 1990-91 to 1994-95 *(Tables A3.9 and A3.10)* and details of the activities in the latest year, i.e., 1994-95.

Both in system and non-system tanks, the maintenance of inlet channels has not been done regularly by the PWD. It did not do any work on these channels during the previous five years in 12 out of the 15 selected system tanks. Special repairs were done in three tanks *(see Table 3.11)*; two of them (Thenur Periya Kanmoi and Maruthur) are multi-village tanks, each serving more than 700 acres of *ayacut*. Moreover, since the supply available from the Maruthur Kanmoi is to be let into several other tanks lower down, the PWD takes special care to maintain the channels. In one case (Alavakottai) the inlet channel was lined in 1990-91.

The brunt of inlet channel maintenance is borne by the *ayacutdars* themselves. Practically all system tanks report that this work has been done five or more times in the last five years with *ayacutdars'* contribution. In five tanks (one each in the head and middle-reaches and all the three in the tail–reach), the work was done 10 to 20 times in the five-year period because blocking of supply channels to these tanks is more serious and frequent. We could not however get any estimate of the value of labour and cash contributions for this work over the last five years. The one tank where no work has been done throughout draws its supply (illegally) by cross-bunding a branch canal of PMC instead of its designated source.

In the non-system tanks also the PWD did not do any work for inlet channel maintenance in 15 out of 21 tanks. In the other six tanks silt clearance, and in a couple of cases construction of retaining walls, was done once or twice in the last five years. Only Ramnad Big Tank (RBT) reports regular work by PWD to maintain inlet channel. This is mainly because it is a very large, multi-village and multi-sluice tank. As with system tanks it is the *ayacutdars* who in fact attend to inlet channel maintenance.

Sixteen tanks report regular maintenance by *ayacutdars* at least once a year; and in a few cases even more frequently. The intensity of maintenance mainly depends upon the extent and frequency of local rainfall in each tank's catchment. If the first showers of seasonal rainfall (during October to December) sets in time, the *ayacutdars* are keen to start their maintenance. If it is delayed, the effort is reduced or in some cases even discontinued. This is the main reason why maintenance in some five tanks was not done every year. In some tanks, if the available catchment supply is abundant, tank *ayacutdars* expend more effort and undertake maintenance work more than once a year. In 4 tanks *ayacutdars* did not attend to inlet channel maintenance: three of them have no inlet channel, while in the case of the fourth the channel has been blocked and no water has been received for 20 years! Again, we could not get the value of *ayacutdars'* contributions to this activity over the last five years. (The contribution in the latest year is described later).

Tank and Related Structures

As for repairs to tank proper (ie. the *bund*, sluices, and surplus weirs), the PWD did not do any work in five system tanks during the last five years. In the rest such works were done only once during this period. Sluice repair was done in seven tanks; reconstruction and strengthening of tank *bunds* in five and tankbed desilting in one. The cost of work ranged from Rs 20,000 to Rs 5 lakh. On the other hand, the *ayacutdars* have undertaken a considerable amount of work on their own. This includes strengthening of *bund* (seven cases), sluice repairs (five cases) and repair of surplus weirs (three cases) involving substantial expenditure. Overall the amount reported to be spent by the *ayacutdars* in this

Table 3.11: Frequency Distribution of Repairs Undertaken by the PWD and *Ayacutdars* in the Selected Tanks, 1990-91 to 1994-95

Reach	Inlet channel				Repairs by PWD				Repairs by *Ayacutdars*			
	Not done	Once	Twice	More than thrice	Not done	Once	Twice	More than thrice	Not done	Once	Twice	More than thrice
System Tanks												
H	6	0	0	0	2	4	0	0	2	1	2	1
M	4	1	1	0	2	4	0	0	4	0	1	1
T	2	1	0	0	1	2	0	0	0	0	0	3
Non-system Tanks												
H	4	2	0	0	1	4	1	0	3	1	1	1
M	3	2	1	0	1	1	2	2	1	0	0	5
T	8	0	0	1	1	1	3	1	1	1	1	6

Note: H: Head-reach; M: Middle-reach; T: Tail-reach
Source: Derived from Tables A3.9 and A3.10.

category of works (Rs 1.3 lakhs) is but a fraction of the amount spent by PWD (Rs 15 lakhs). But in some cases the *ayacutdars* expenditure is almost as large as that of PWD.

Ayacutdars' involvement is concentrated in the head and tail-reach tanks. Four of the six head-reach tanks and all the three tail-end tanks against two out of six middle-reach tanks report repair that was done by *ayacutdars*. Most of those who undertake such works have done so twice or thrice in the last five years and often in addition to PWD work. *Ayacutdars* did not take up any repairs in half of the tanks (mostly in the middle reach) but in four of them the PWD had done some repairs.

In the case of non-system tanks, PWD did some tank-related repairs in 15 out of 21 tanks: strengthening and filling in breaches in the *bund* is the most frequently reported work (10 cases), followed by sluice repair (7), reconstruction of surplus weir (5) and building a retaining wall. In a majority of cases, work was done only once or twice in the past five years. The frequency of this category of repair work is more in the tail–reach tanks, Here again Ramnad Big Tank receives greater attention. The average PWD outlay per acre of *ayacut* for inlet channel and tank repairs is highest in the middle-reach tanks, and the least in the tail–reach.

In a large majority of the non-system tanks (16 out of 21) *ayacutdars* themselves have spent considerable effort on strengthening of *bunds* (11 cases) sluice repair (11 cases) and other tank-related maintenance. In a majority of tanks the growth of water plants, locally called as *Aathalai*, inside the tankbed made it difficult to use the tank water efficiently. It restricted the flow of water available into the tank and considerably reduces the capacity of tank. Though this problem is common in most of the tanks it is reported to be more severe in the tail-reach tanks. As a result, in four of the tail–reach tanks the *ayacutdars* spent a sizeable sum for removal of this plant. Overall, the highest amount spent for repairs/maintenance of tanks is in the tail–reach followed by middle and head-reaches.

Practically all tail–reach and five out of six middle reach tanks report having undertaken tank-related repairs. In most of the cases such works have been done in three or more years during the past five years. The intensity of *ayacutdars'* works and their frequency is relatively low in the head-reach tanks. The expenses incurred by *ayacutdars* of non-system tanks relative to total outlay on repairs is lowest in the head reach, and highest in the tail-end and considerably higher than in the system tanks.

On the average over the last five years, the PWD has spent relatively more per hectare of *ayacut* for maintenance of supply channel and tanks of system category (averaging about Rs 215 per hectare per annum) than the non-system category (Rs 85 per hectare per annum) over the last five years. In system tanks the amount spent is lowest in the head-reach tanks followed by tail- and the middle-reach tanks. The outlay on the middle reach being nearly six times that of head reach tanks. Among non-system tanks, per hectare PWD spending is also the least in the head reach, and roughly the same in the middle and tail-reach tanks. The PWD's priorities in inter tank allocations clearly differ between the two categories of tanks. *Ayacutdars'* contribution to tank-related repairs (per hectare of *ayacut*) during the last five years -figures for inlet channel works are not available — is considerably higher (both in absolute terms and relative to that of PWD) in non-system tanks. The relative contribution of *ayacutdars* in these tanks is highest in the tail-end and the least in the head. Among system tanks, the farmers' involvement is highest in the head reach *(see Tables A3.9* and *A3.10)*.

DISTRIBUTION NETWORK

The desilting and repair of the distribution network (main, branch and field channels) are, in all cases, wholly taken care of by *ayacutdars*. All *ayacutdars* are expected to contribute labour or cash for main and branch channel maintenance. Maintenance of field channels is the responsibility of individual *ayacutdar* through, or by, whose land the channels pass. This practice is common to both system and non-system tanks.

Most system tanks report that main/branch channel maintenance is done regularly, at least once a year. Some (two in the head reach which get supplies for two seasons and three in the tail-end) report that this work is done twice a year, once every season. Work on field channels is reported to be done once a year. The picture is somewhat different in non-system tanks: Most tanks report maintenance work on distribution channels at least once a year. Some (one in the head, two in the middle and three in the tail), report working on branch channels twice a year on the average. In tanks (especially two in the tail) where water supply is rather precarious and uncertain, channel maintenance is done as and when supplies are available.

DETAILS OF WORK DONE IN 1994-95

Details of work done, labour contribution, wage rate, extent of participation, basis of contribution and levy of penalty for non-participants in the year of survey (1994-95) were obtained from knowledgeable villagers (*nattanmaikars, thalaiyaries* and irrigation functionaries)

in each village *(see Annexure Tables A3.11 and A3.12)*. Work on inlet channel maintenance is reported to have been done more than once in five system tanks (on each in the head and middle-reaches and all the three tanks in the tail–reach). In one case (Rajagambiram tank) it was done four times in 1994-95 because of frequent blockage of the channel by numerous eating houses located along the channel. In the tail–reach of Mudikandam inlet channel had to be cleared thrice in 1994-95 because its supply depends solely on its catchment run-off and surpluses from the upper reach tanks. As a result, whenever rainfall occurs *ayacutdars* are vigilant about keeping the channel clear to ensure as much supply as possible from these sources. In the remaining two tail-reach tanks, though the channels are fully lined, the height is not enough to convey adequate supply. As a result, a large quantity of water overflows. In order to prevent this, maintenance was done twice a season.

Participation of *ayacutdars* in maintenance of inlet channel was reported as 100 per cent in seven system tanks (three each in the head and tail-reaches and one in the middle), 75-80 per cent in three villages and 40-60 per cent in another four villages. *Ayacutdars'* contribution could be in the form of own labour or cash for hiring labour. In eight tanks, labour was contributed entirely by *ayacutdars*; three report using wholly wage labour. The labour input for this activity varies from a fraction of a humanday per acre of *ayacut* to a maximum of 2.2 person days, the figure being less than half a person day in a majority of cases. It is relatively higher in the head and the tail–reach tanks than in the middle.

All non-system tanks which have an inlet channel and which received supplies (17 in number) did maintenance work on the channel during 1994-95. A few did it twice in the year. The average labour input per acre varies from as little as one-tenth of a human day to nearly three human days; eight spent more than one human day per acre. Overall, non-system tanks spend more time in maintaining inlet channels. The relative importance of *ayacutdars* labour and hired labour also varies: eight reporting use of only labour contributed by *ayacutdars*, five depending exclusively on wage labour, and seven using both.

Distribution Network

The majority of system tanks reported that maintenance of main/branch channel was done once during the year. Only four tanks (one in the head reach and all three in the tail–reach) did this work twice in the year. In six tanks (two in head reach, one in middle and all the three in tail–reach) work was done wholly by *ayacutdars*. In a majority both *ayacutdars* and hired labour were used but, even in these cases the bulk of the labour was contributed by *ayacutdars*. All the tanks report that work on field channel maintenance was done during the year exclusively with *ayacutdars'* labour. Except three middle reach tanks *ayacutdars* are reported to have given their contributions for maintenance of channels. Even in the three middle-reach tanks, where 60 per cent participation was reported, no penalty for abstaining from maintenance activity was imposed. Only two tanks imposed a penalty for *ayacutdars'* failure to contribute to maintenance.

All non-system tanks also report having done maintenance work on main/branch channels as well as field channels. In 14 of them work on main/branch channels was done once during the year. In six tanks (one in the head, two in the middle and three in the tail) it was done twice because the channels of those tanks are heavily silted due to encroachment and require proper maintenance. In three tanks maintenance was done only as and when supply is available through rainfall. The proportion reporting exclusive reliance on *ayacutdars* is much higher (13 out of 21 tanks) compared to system tanks (six out of 15). In seven tanks (two each in head and middle-reaches and three in the tail) engagement of hired labour was reported. The extent of participation in this type of channel maintenance was reported 100 per cent in all the tanks (except two). Penalty for non-participation in maintenance is reported to be rare.

Field Channels

All system and non-system tanks report that maintenance of field channels was done at least once in 1994-5. In several non-system tanks it was done twice. The labour requirements were, in all cases, contributed wholly by the *ayacutdars*.

The overall quantum of labour input for maintenance of distribution network (main branch and field channels) varies from as little as 0.15 humanday per acre to over $2^1/_2$ human days in the case of system tanks. Seven of them report between 0.75 and one human day per acre; and three more than one human day. The range in non-system tanks is wider: from about 0.4 human day to over 4.5 human days. But the large majority of them (13 out of 21) report more than one human day per acre. Clearly channel maintenance is given greater attention and takes greater effort in non-system tanks. In general the head and tail–reach tanks devote more time to this work than the middle reach in both categories of tanks. The intensity of effort in tail-reach tanks is on the whole higher than in head-reach tanks.

The figures of labour input and its money value (at prevailing wage rates) obtained in a rapid survey of selected villages can of course be only approximate. Nevertheless, it does show that farmers' contributions and participation are nearly universal and substantial, with significant variation across different categories of

tanks. It is also clear that direct labour contribution of farmers is substantial and accounts for a large part of the resources needed for this activity.

Ayacutdars' contribution is mainly on a per acre basis; but in several villages, it is fixed on a per household basis. The contribution is generally in the form of labour, but cash contributions are also allowed in lieu of own labour. The estimated value of farmers contributions in 1994-95 to repair and maintenance of different tank-related facilities individually and in the aggregate are detailed in *Annexure Tables A3.11 and A3.12*. On the average, *ayacutdars* of selected system tanks contribute Rs 43 per acre; and those served by non-system tanks considerably more, the average being Rs 71 per acre. In four-fifths of the system tanks this figure is less than Rs 25 per acre, and one fifth report more than Rs 100 per acre. Among 18 non-system tanks covered only three report less than Rs 25 per acre; as many as six report more than Rs 100 per acre. This does not include payments to *neerkatties* and *thotties* which range from about 4 kg to nearly 20 kg of paddy per hectares. Tank farmers obviously incur considerable expenses to secure water supplies.

Villages often supplement these contributions with other sources: Some villages collect a levy on sale of village produce (*magimai*). Several tanks (both system and non-system) get money by auctioning fishing rights in the tank: six of the non-system tanks get resources from sale of wood from community land. Duck rearing and sand sales are reported by two system tanks and donations by two non-system tanks. In the case of unusual repairs and exceptional circumstances, special levies (on acreage or house hold basis and occasionally as donations) are collected. *Table 3.12* gives some idea of the varying practices across villages.

A number of villages (seven system tanks and seven non-system tanks villages) have built up sizeable reserves (ranging from Rs 5,000 to Rs 50,000) which are used partly or wholly to finance tank-related maintenance work *(see Tables A3.13 and A3.14)*. In the system tank villages, the practice seems to be to treat these collections as a fund for village level community activities. By contrast, the non-system tanks which have accumulated such funds seem to earmark them for tank-related activities.

WATER ALLOCATION AND MANAGEMENT

Regulating the allocation of water between different segments of the command in each tank is the other important task of tank management: Except in multi-village tanks which are relatively big (3 out of 15 in the case of system tanks and only one out of 21 among non-system tanks), it is handled almost entirely by the local irrigation community served by these tanks. Typically there are no formal rules but each community has evolved conventions about the basis for deciding when the sluices are to be opened and closed; how they are to be operated; how the distribution of water within the *ayacut* is to be regulated; and what to do in the event of short supply.

Release of Water from the Tank

The large majority of system tanks (11 out of 15) report that they start releasing the water as soon as PMC begins

Table 3.12: Number of Tanks Reporting Various Sources of Funds for Tank Maintenance and Operation Under PVB, 1995

Reach	No of tanks	*Magimai*	Fish auction	Wood sales	Duck rearing	Sand sales	Levy on *Ayacutdars*			Availability to capacity	Donations
							per acre	per HH	*		
1	2	3	4	5	6	7	8	9	10	11	12
System Tanks											
H	6	2	3	0	1	1	2	2	0	0	0
M	6	0	2	0	0	0	1	1	1	1	0
T	3	0	2	0	0	0	2	1	0	0	0
Total	15	2	7	0	1	1	5	4	1	1	0
Non-system Tanks											
H	6	0	1	1	0	0	5	1	0	0	0
M	6	0	3	2	0	0	3	1	0	1	0
T	9	0	3	3	0	0	3	2	0	1	2
Total	21	0	7	6	0	0	11	4	0	2	2

Note: *Indicates that the ayacutdars who face more problem could pay more amount specifically to solve that problem; HH: House hold
Source: Survey, 1995.

supply. This may be because the selected tanks for the most part happen to be located in the upper reaches of the branch canals feeding them. Four tanks (two each in the middle and tail-reaches of the basin) which are located a little away from the main canal, release water only after the tank gets one-month storage. It should also be noted that most of the tanks, especially those located in the tail–reach, are not getting the PMC supply continuously, but receive the supply once in a month or once in a fortnight, and in a few tanks as and when required. In such a circumstances, if the supply is not released at the specified time and rainfall is inadequate, farmers may face scarcity in supply. This has happened to the tail-end tanks in some years.

By contrast, all the non-system tanks release water when the tank gets filled to a level considered reasonable. What is considered "reasonable" varies. Thus most tanks situated in the upper and middle-reaches of the basin release supplies when they have one month (and in a couple of cases two months) storage. At the tail-end of basin a minimum two months (in a couple of cases three months) is considered necessary before releasing water. The conservatism of non-system tanks in this respect is understandable. Given the high rainfall variability, they would like to minimize the risks of crop failure due to lack of water after the crop is sown. This consideration is likely to be stronger in the tail-reaches.

SLUICE OPERATION

Tank sluices are generally operated under the supervision of the village *ambalam/nattanmai*. In a majority of system tanks (eight out of 13) sluices are operated by *ayacutdars* themselves. The arrangements seem very flexible. Thus in one case (Perungalakudi) one big land owner who lives adjacent to the tank keeps the sluice key. Any *ayacutdar* can get the key to release water from the sluice for his use. In Namanur any farmer can open the sluice in the morning but it is closed at six pm every day by the sluice closer (who was appointed for this purpose). After six pm irrigation is not permitted. In all other tanks, sluices are to be operated by authorised functionaries (the government appointed *lascar* in one case and *madaiyan/thotti* in others) under the supervision of the village leaders *(see Annexure Tables A3.15* and *A3.16)*.

Sluice operation in non-system tanks is marked by much stricter regulation: The *madaiyan* (and *thotti* in one case) is responsible for this function in a majority of non-system tanks (15 out of 21 tanks) under supervision of leaders of the irrigation community or, where there is no irrigation board (IB), by the concerned PWD official. In the remaining tanks, *ayacutdars* are free to operate the sluices on their own.

As a rule, sluices of smaller tanks are opened for irrigation in the early morning around six am, water is let out throughout the day and closed at six pm In some bigger tanks (like RBT) where the command area is large, the sluices are opened throughout day and night. They are to be closed only when the *ayacut* gets heavy rainfall or the *ayacutdars* request its closure for maintenance purposes. In RBT, once water is let out, it continuously flows along the main and branch channels from the head reach village to the tail-end of the *ayacut*. However, to facilitate irrigation of *ayacut*, several villages divert supply from the channels through such arrangements as *kondam* (a temporary earthen embankment to raise the water level to irrigate elevated lands); *mattu* (a masonry structure of a specified dimension from which two or more channels take off to supply water to the *ayacut*); and diversion vents (vents constructed in appropriate places with specified dimensions) to divert water from the main/ branch channels.

SOWING DECISIONS

In a majority of tanks, farmers are free to decide whether to sow and what to sow without any interference from the IB or the village organisation. The individual farmer makes his decisions on the basis of storage available at the time of sowing and his judgement of the likely availability during the entire crop season. Farmers who have access to wells are clearly in an advantageous situation. But, for the non-well farmers, the level of storage in the tank at the beginning of the season is a crucial determinant in their decisions to raise the crop. Low storage at sowing means higher risk that all lands in the *ayacut* may not get adequate supply for the entire crop season: The risk being greater for lands commanded by the elevated sluices and tail-end plots of even the deepest sluice. Under these circumstances the farmers located at the tail-end as well as in the elevated sluices tend to grow shorter-duration or dry crops.

When there is enough storage in the tank at the initial period of sowing, then there is no problem in water sharing among the *ayacutdars*. In such a circumstance, in all the tanks, it is reported that water can be liberally used by the farmers as per their requirements. Only in the tail–reach of Alavakottai water is distributed by *neerpaichies* even during the normal period as per their customary procedure.

Several system tanks (all the head reach and a few middle-reach tanks) reported that they did not face any scarcity in the initial sowing phases. However, many others experience inadequate supply at the time

of sowing and manage the situation in one of several ways: some seem to delay release of water till there is at least one month storage in the tanks; some do not raise any crop depending only on tank water; and some restrict tank supply initially for raising nurseries.

None of the non-system tanks in the head reach and a few in the middle reach of the basin impose any area/crop/time restriction in the initial phases. If there is shortage in tank supply, the individual farmers bear the risk of losing crops sown. Others do impose restrictions on extent of area sown using tank supplies: For example, in one case only paddy is allowed to be grown using tank water; raising other annual crops is prohibited. In another middle reach tank, when storage is inadequate, farmers are advised not to start sowing operations expecting tank water to be available. There are cases (e.g., Urappuli tank) where only head reach farmers are allowed to cultivate; farmers in all segments are permitted to sow but only short-duration paddy and that too in a specified portion of their land; and, limiting the absolute area which a farmer can cultivate.

Allocation Between Channels

Within the *ayacut,* the fact that sluices are situated at different levels provides an automatic mechanism for rationing available supply. Normally, in larger tanks (like Ramnad Big Tank) sluices are arranged at three levels, viz., deep, middle, and the elevated. Naturally, the deep sluices get earlier supply followed by middle and the elevated sluices. In some cases, the elevated sluices cannot draw any supply till the tank reaches near FTL. As the tank storage falls from FTL, the depth of supply available at the sills of the sluices also decreases automatically. Consequently, the elevated sluices face water shortage first. Any further decrease in storage leads to stoppage of supply to the elevated sluices. The higher the sluice the lower is the volume available for its *ayacut,* shorter the duration of supply and greater the uncertainty. The deep sluices on the other hand will begin getting supplies as soon as the tank gets water; they can draw water for a longer period and with greater certainty.

Most of the system tanks surveyed allow farmers to use tank supplies according to their needs during normal supply. Only one tail-end tank (Alavakottai) follows a system of supervised distribution with *neerpaichies* regulating supply from tail to head. Shortage of tank water toward the end of the supply season is a more frequent problem. In this event those who have wells use groundwater to make up for scarcity of tank water: three of the head reach tanks mentioned this practice. Purchase of well water by those without their own well is also reported. Its extent is not known but seems unlikely to be widespread or significant.

Most system tanks manage shortages by introducing some form of rationing of tank supply. The most common method in vogue (five out of 15 system tanks) is regulated distribution from head of the *ayacut* to the tail. Under this system the turns are determined by location of the plots, the needs of upper reach plots being met before letting water to those lower down. The burden of scarcity naturally falls more heavily on the latter. The tail-to-head distribution, which is designed to give more water to those who are disadvantageously located, is reported only in one tail-end tank. Two tanks use *madaipaichal* which is a system of rotation by channels; one rations by fixing duration of supply per acre. Two middle-reach tanks report that no attempt is made to ration end-season scarcity, leaving the fate of crops to be determined wholly by rainfall *(Table 3.13).*

The introduction of rationing goes with much stricter regulation and supervision of water release and use: In some of the system tanks this task is entrusted to experienced *ayacutdars* specifically appointed for the purpose. One tail-end tank entrusts the task to *neerkatties* while a middle-reach tank (Pottapanaiyur) four non-*ayacutdars* are appointed to supervise irrigation during scarcity.

Table 3.13: Methods of Rationing Water at the End of Irrigation Season, 1995

	System tanks								Non-system tanks							
Reach	Head to tail	Tail-to-head	Rotational supply	Rationing by time	No water to well farmers	Rationing by area	Adjustment by *ayacut*-dars	None	Head-to-tail	Tail-to-head	Rotational supply	Rationing by time	No water to well farmers	Rationing by area	Adjustment by *ayacut* dars	None
H	3	–	1	1	–	–	1	–	4	1	–	–	–	–	–	1
M	2	–	1	–	1	–	–	2	1	–	2	1	1	–	1	–
T	–	1	–	1	–	–	1	–	1	–	4	1	–	2	1	–
Total	**5**	**1**	**2**	**2**	**1**	**–**	**2**	**2**	**6**	**1**	**6**	**2**	**1**	**2**	**2**	**1**

Note: H = HEad-reach; M = Middle-reach; T = Tail-reach
Source: Survey, 1995.

While the head-to-tail system is also widely practiced in non-system tanks (six out of 21 report this), rotational supply is used more frequently (six tanks) than in system tanks. There are also different variations of this method: (1) The channels or the *ayacut* are divided into segments and each is irrigated in a specified sequence for a specified period. Melakkal Kanmoi, for example, divides the channel into four segments, two of them irrigated by day and two by night, with *ayacut* of elevated sluice getting priority over the deep sluice. Rotation by sluices is also reported in Vannariruppu Kanmoi. *Perungudi* divides ayacut into two portions and each is given three days supply alternately during the day; (2) *Vaaimadai* system by which water distribution is regulated at the outlets from each channel to the field; and, (3) One way channel method by which only one side of the channel *ayacut* is irrigated at a time, and the supply is alternated between the two sides. This is practised in four tanks, all in the tail–reach.

Restricting the acreage for which water will be supplied (specified as a proportion of the area operated) is practised in two tail-end tanks. Rationing on a first-come-first-served (one tank), denying water to well owners, restricting the overall duration of supply to a few days in a week (one tank) are other methods. Overall, the rationing procedures are more varied and articulated in greater detail in the tail-end tanks. Unlike the head and middle-reach tanks which do not permit night irrigation, most of the tail-end tanks allow irrigation both during day and night. The responsibility for enforcing the rationing is left to farmers in some cases and to irrigation functionaries in others.

The above analysis clearly indicates that non-system tanks followed relatively more elaborate and varied practices of water shortage management during deficit supply period than system tanks. This is mostly due to the fact that the non-system tanks are relatively getting poor/less supply of water from the sources compared to the system tanks. Moreover, the availability of supply to non-system tanks mostly depends upon the proper onset of monsoon. If the monsoon fails the tanks will also get no supply. Because of these reasons non-system tank *ayacutdars* are vigorous in maintenance and management of tank irrigation system.

The relative intensity of effort in managing water allocation, measured by scoring system covering five major functions shows that non-system tanks are more active than system tanks, especially in the selected head and the middle-reach tanks. The score for tail–reach non system tanks is slightly lower than their counterpart in system tanks. The difference between reaches is much more marked in system tanks than in non-system tanks *(Table 3.14)*.

Table 3.14: Average Score for Water Allocation as Reported in Selected Tanks

Reach	System	Non-system
Head	5.5	6.8
Middle	5.8	6.0
Tail	7.7	7.4
All	6.3	6.7

Note: This covers sluice operation, release of water, allocation practices in normal supply and in scarcity periods and methods of rationing. For details see Appendix 3.

EFFECTIVENESS OF INSTITUTIONS

It should be evident from the foregoing account that tanks in the PVB are for the most part in active use. Inlet channels, *bunds* and sluices are in many cases in a state of disrepair, some seriously so. Complaints of the tankbed siltation are widespread. But no tank has been abandoned. And none reports any reduction in the extent of *ayacut* irrigated; in fact some report an increase. It is also clear that PWD has not fulfilled its obligations for maintenance of inlet channels and tank structures. But *ayacutdars* put in considerable resources and effort to make up for PWD's neglect and also to maintain the distribution networks. The village level organisations are largely informal but active: a sizeable proportion of them have functionaries to help in tank management; they have rules in respect of maintenance contributions from *ayacutdars*, and water allocation in times of scarcity, and efforts are made to enforce them. At the same time it is also apparent that there are considerable variations between tanks in the manner and effectiveness of management.

The effectiveness of irrigation institutions has of course to be ultimately judged by the impact on productivity of land. Since this is not possible, we have to rely on broader measures: the quality of maintenance of facilities and the management of water scarcity are two key indicators. These two activities are very important in determining the availability of tank water to individual farmers located in various reaches of the system. Proper maintenance of channels and distribution network enhances the storage available to the tank and facilitates smooth flow of water to all parts of the *ayacut*. The management of water determines how the available supplies are allocated among different segments of the *ayacut*. Clear rules and effective enforcement reduce conflicts and also ensure a fair distribution of water, and hence additional production, among the farmers in the *ayacut*. The ability to perform these functions depends in part on the availability of experienced personnel specialised in administering tank-related tasks.

HEALTH CELL

Tanks evidently differ in their management of the above tasks. In an attempt to get a composite index of "effectiveness" we have devised a rather simple scoring system in respect of the following: (1) Three types of maintenance activity (inlet channel, main and branch channels and field channels); (2) Repairs undertaken by PWD and *ayacutdars* in relation to tank-related structures; and, (3) The practice of rule-based rationed allocation during scarcity; and, (4) The number of specialised functionaries relative to *ayacut* area.

In respect of (1) and (2) the scoring is based on the number of times for which the specified works were done in each tank during the past five years. As for rationing practices, we only differentiate between those which have rationing in times of scarcity and those which do not. Scoring for (4) is based on the number of functionaries per 40 hectares. (Details of the bases for determining the score in respect of each variable is indicated in the *Annexure Table A3.17)*. The overall rating of "effectiveness of management" is simply the sum of the scores for individual variables. This index undoubtedly admits of refinement both conceptually and in terms of measurement. Nevertheless, it provides an approximate basis for comparing the performance of community institutions.

The point scores of each selected system and non-system tank in respect of performance indicators individually and in the aggregate indicate that immense variation in performance is highlighted by the fact that the overall score ranges from two to 15 (the possible maximum being 16 points). The mean score for system and non-system tanks is roughly the same, but non-system tanks have a relatively higher proportion of both good and poor performers. The reasons for these differences in performance are worth exploring.

Tanks are par excellence examples of common pool resources managed by user communities. In so far as irrigation makes a significant difference to productivity of land, the *ayacutdars* have a common interest in community management. The extent of the productivity gain depends of course on the characteristics of water supply from the common source and on agro-climatic conditions. In PVB, irrigation does make a significant difference to productivity, the average output per unit of irrigated land being 4.7 times that of rainfed lands in Madurai district and 3.9 times in Ramanathapuram (Vaidyanathan et al. 1994c). But since there are differences in the quantum, duration and assurance of tank supplies as well as in the extent of conjunctive use in their command, one would expect the productivity impact and the strength of interest in collective management also to vary.

A second factor is the condition of the physical facilities: The better maintained they are, the larger the likely supply of water. If they are in poor condition, it takes greater effort on the part of the user community to ensure that these facilities are kept in good repair. However, the incentive for community effort is a function of the relation between maintenance effort and water supply. It has been suggested that the incentive is weak both when water supply is abundant relative to crop needs, and also when it is very much short of the needs of the *ayacut*. The incentive is greatest when (a) the supply is significantly affected by the degree of effort put into collective maintenance; and, (b) the resulting supplies make a significant difference (in terms of quantum, duration and assurance) to the moisture available from local rainfall. The lower, and the more variable, local rainfall, the greater the productivity of irrigation.

In the case of rainfed tanks the potential yield of catchment is likely to be less and more variable compared to system tanks. The impact of maintenance depends on the catchment area, the capacity of the reservoirs relative to the *ayacut*, and on how many other irrigation sources there are upstream. In general the larger the capacity per unit of *ayacut*, and larger the catchment,the greater will be the benefit of collective maintenance. Head reach tanks will have greater incentives than tail–reach. In system tanks, the pattern of relationship is likely to be significantly altered because of the possibility of harnessing surface flows from a much wider catchment. The importance of local rainfall relative to that of the larger system, and the location of the tank relative to the source will make a difference.

The possibility of supplementing tank water with groundwater in the *ayacut* is another significant factor. Where the groundwater is available, shortage in tank water can be made good by pumping groundwater. One may therefore expect that the more abundant groundwater supplies relative to *ayacut* needs, the weaker will be the incentive for participating in collective maintenance and operation. Even where it is not so abundant, if leading *ayacutdars* (usually larger land owners who take active part in management) can directly pump groundwater in the *ayacut* for their needs, their interest in the tank will be weakened. This may in turn make them less interested in shouldering the responsibility for community management. However, this tendency is countered by the fact that the groundwater available in the *ayacut* largely depends on seepage from the tank and the application of tank water for irrigation.

Finally, effective management depends a great deal on the existence of clear and well-understood rules regarding sharing of costs and benefits from the use of tank water; and an authority capable of enforcing compliance with the rules. In the past there was a high

degree of congruence between social (caste) and economic (land holding) hierarchy in villages. The dominant land owners belonged to upper castes. They were relatively few in number and had the power to make and enforce rules in respect of community activities like tank management.

Over time, the dominance of upper castes in land ownership has declined and most have migrated to the towns. Land control has passed to the numerically larger middle and lower castes. In many cases more than one populous caste has acquired land ownership. Their numbers have also increased as a result of population growth. The growing social and political links with the outside exposes the village community to external pressures and also opens more opportunities for external influences to intervene in village matters. As a result of all this, traditional power structure within the village has become looser and, in some sense, its ability to enforce rules has weakened. While we cannot assess the importance of the external factors, it seems reasonable to suppose that villages where a single caste is dominant (in terms of numbers and land ownership), there are greater chances of effective community management than in villages where land ownership is diffused over more than one caste.

A rigorous test of these hypotheses is not possible with the available data. Apart from the fact that much of the information is derived from rapid survey based on interviews with a few knowledgeable people, the influence of different characteristics on management are not additive but interactive. Given these limitations, and the crude scoring system, no statistical analysis is possible. Nevertheless, the data do seem to suggest some broad patterns of association.

The overall average rating of community effort in system tanks is roughly the same as that of non-system tanks. About half the tanks in both categories are "very active" (with a score of 12 or more points against a possible maximum of 16). Nearly half the system tanks (7-15) can be described as "quite active" (scores of 6-11) the proportion among non-system tanks being some what less at around 30 per cent. Relatively less active community effort is found more frequently among non-system tanks. All system tanks supply water for more than three months compared to only six among non-system tanks. The proportion reporting relativley high variability in supplies is also large among non-system tanks. On the other hand, a larger proportion of non-system tanks are single-caste villages and villages with low well density relative to tank *ayacuts*.

In an attempt to probe deeper, the tanks are classified on the basis of their ratings. This distribution along with the characteristics of tanks in each category which are likely to influence the strength of community management are presented in *Table 3.15*. Several features are noteworthy.

Among system tanks, location does not seem to have a significant association with the degree of com-

Table 3.15: Characteristics of Tanks in Periyar-Vaigai Basin Classified by Level of Activeness of Community Institutions

Scoring for intensity of activeness	No of tanks	Number of tanks according to												
		Duration of water supply *			Location **			Variability ***			Well density ****			Single caste domination
		1	2	3	H	M	T	High	Medium	Low	Low	Medium	High	
System Tanks														
5 or less	–	–	–	–	–	–	–	–	–	–	–	–	–	–
6 – 8	1	–	1	–	1	–	–	–	1	–	–	–	1	1
9 – 11	7	–	7	–	3	–	4	–	–	5	5	1	1	3
12 or more	7	–	5	2	3	–	4	–	4	3	4	2	1	1
Non–system Tanks														
5 or less	2	2	–	–	1	–	–	–	–	–	1	–	1	2
6 – 8	1	–	1	–	–	–	1	–	–	1	1	–	–	–
9 – 11	8	2	5	1	4	1	3	3	3	2	5	1	1	4
12 or more	10	1	4	4	1	4	5	1	3	6	8	–	–	4

Note: *: 1 = < 3 months, 2 = 3–4 months, 3 = > 4 months. **: H = Head, M = Middle, T = Tail. ***: M = Mimimum supply/Maximum supply during 1992–94, High = < 40%, Medium = 40–80%, Low = > 80%. ****: % of area using well water conjunctively: Low = < 20% Medium = 21–40%, High = > 40%.

Source: Field survey, 1995.

munity activity in management. Very active and active institutions are equally numerous in both the head and the tail segments. Very active tank communities have a larger/proportion with longer duration though not of those with more reliable supplies. The well density in both categories is low. The one village with less active institutions has less water but more assured supply, but happens to be at the head reach and with high well density. Caste composition does not seem to be a significant factor; the large majority are multi-caste villages and there is no indication that the relative frequency of single caste villages is high among communities with very active institutions.

The pattern conforms more to expectations in the non-system tanks. The two tanks with least active institutions (score of 5 points or less), have less than three months supply and inter-year variability is high; one of them has a high well density. The relative frequency of tanks in the tail-end, those with four or more months water supply, more assured supplies (min/max > 80) and low well density are higher in communities with very active institutions than those where they are only moderately active. Caste homogenity of *ayacutdars* does not seem to be a significant factor. ■

Table A3.1: Characteristics of Selected Periyar-Vaigai System Tanks, 1995.

Tank sl no	Name of tank	Reach	villages served	Number of sluices	of tank surplus weirs	Depth storage (mts)	Original supply at capacity (MCM)	Duration of FTL (Months)	Registered ayc PWD	Reve
1	2	3	4	5	6	7	8	9	10	1
1	Parali	HR	1	4	1	0.9	0.194	2.0	80.1	80
2	Thiruvalavayanallur	HR	2	8	1	2.1	0.666	1.3	136.7	150.
3	Mannadimangalam	HR	1	6	2	2.4	0.966	3.5	210.5	210.
4	Kuravakudi	HR	1	2	2	3.3	0.764	2.5	64.1	64.
5	Ariyapatti	HR	1	3	2	3.3	0.760	2.0	112.8	105.
6	Poduvarpatti	HR	1	1	1	2.7	0.124	2.0	22.0	22
7	Rajagambiram	MR	1	2	1	1.2	0.091	1.2	40.9	40
8	Pottapanaiyur	MR	1	4	1	2.4	0.119	1.3	113.7	52.
9	Thenur Periya Kye	MR	2	5	2	2.7	0.827	1.3	273.7	274
10	Perungalakudi	MR	1	2	1	1.5	0.102	0.7	68.4	68.
11	Punjuti	MR	1	4	1	2.1	0.320	1.3	132.3	183.
12	Maruthur	MR	3	3	1	2.4	0.886	1.3	392.3	392
13	Mudikandom	TR	1	3	4	3.9	1.285	3.0	80.4	152
14	Alavakottai	TR	1	4	1	3.0	0.661	3.0	88.0	114.
15	Namanur	TR	1	3	1	3.0	0.700	3.0	168.6	175.

Note: Na = Not available; HR = Head-reach; MR = Middle-reach; TR = Tail-reach; Column 7: Depth at the deepest sluice of the tank. WSA = Water spread area; FTL = Full tank level

Source: Memoirs, VAO records and group interviews held with the *ayacutdars* of respective tanks.

(*Ayacut* in Hectares)

ıge capacity/ ıre of :ut (8/10) M/hectares)	Water spread area (WSA) (hectares)	WSA/ *ayacut* (13/10) (hectares)	Average depth (8X100/13) (metres)	Free catchment area (sq km)		Greatest width of WSA (metres)	Length of *bund* (metres)	Max. flood discharge (cu secs)	Total length of main channels (km)	Class of tank	Single/ double crop (S/D)
				Total	Per hectares of *ayacut* (16/10)						
12	13	14	15	16	17	18	19	20	21	22	23
.0024	19.4	0.2	1.0	2.46	0.0307	50	1700	268	3.0	II	D
.0049	164.5	1.2	0.4	16.19	0.1184	600	4050	547	9.0	IV	S
.0046	189.6	0.9	0.5	1.30	0.0062	800	2090	826	8.0	II	D
.0119	174.4	2.7	0.4	5.28	0.0823	730	2090	3017	2.0	IV	S
.0067	182.1	1.6	0.4	32.04	0.2841	750	2160	2948	3.5	IV	S
.0056	35.9	1.6	0.3	2.10	0.0954	218	900	261	2.0	IV	S
.0022	12.0	0.3	0.8	1.04	0.0253	50	850	Na	0.8	IV	S
.0010	13.8	0.1	0.9	Na	Na	600	800	Na	3.5	IV	S
.0030	67.2	0.2	1.2	19.94	0.0729	660	3575	Na	10.0	IV	S
.0015	12.5	0.2	0.8	Na	Na	100	250	Na	2.5	IV	S
.0024	28.9	0.2	1.1	6.73	0.0509	450	850	Na	6.5	IV	S
.0023	71.6	0.2	1.2	7.90	0.0201	1100	1475	300	3.8	IV	S
.0160	101.2	1.3	1.3	8.47	0.1053	2310	2745	1237	4.3	III	S
.0075	168.2	1.9	0.4	7.17	0.0815	600	1950	1867	5.0	III	S
.0042	173.8	1.0	0.4	19.22	0.1140	900	1590	2344	4.0	III	S

s of tanks: < 3 months = class IV; 3-6 months = class III; 6-9 months = class II; > 9 months class I. (For more details see GO 2501 PWD, GOM, 3-6-1914).
mn 9: As per farmer's experience (approximate). The figures show the duration of supply available only at FTL, it does not take into account the no of fillings in a year.

Table A3.2 Characteristics of Selected Periyar-Vaigai Non-System Tanks, 1995.

Tank serial no	Name of tank	Reach	Number of			Depth of tank (metres)	Original storage capacity (MCM)	Duration of supply at FTL (months)	Registered *ayacut*		Storage capa hectare o *ayacut* (8/ (MCM/hectc
			villages served	sluices	surplus weirs				PWD	Revenue	
1	2	3	4	5	6	7	8	9	10	11	12
1	Kunnuvarayankottai	HR	1	3	2	3.0	0.719	3.0	76.8	77.8	0.0094
2	Melakkal kye	HR	1	3	2	2.4	0.533	2.0	159.1	158.2	0.0034
3	Ettilodu	HR	1	2	1	3.3	0.360	3.0	216.2	121.8	0.0017
4	Kudiseri	HR	1	2	1	2.4	Na	3.0	87.0	91.5	Na
5	Elumalai	HR	1	3	2	4.8	0.953	3.0	88.3	102.2	0.0108
6	Mudalaikulam (E)	HR	1	3	3	2.7	0.955	3.0	125.8	125.8	0.0076
7	Perungudi (E)	MR	1	2	1	3.3	0.932	3.0	93.3	93.3	0.0100
8	Othai Alankulam	MR	1	4	2	3.3	1.071	2.0	103.2	103.2	0.0104
9	Panaiyur	MR	1	5	1	1.8	0.864	2.0	260.3	259.1	0.0033
10	Vannariruppukanmoi	MR	1	4	1	3.3	0.114	0.7	89.1	88.9	0.0013
11	Pudukulam (E)	MR	1	5	2	4.2	0.965	3.0	93.5	93.5	0.0103
12	Semini kye (E)	MR	1	4	1	3.0	0.811	3.0	130.4	130.4	0.0062
13	Okkur	TR	1	4	1	2.1	0.337	2.0	84.3	86.1	0.0040
14	Nariyankudi	TR	1	5	1	2.4	0.822	3.0	91.6	102.5	0.0090
15	Usilankulam	TR	1	4	3	3.3	0.923	5.0	112.3	115.4	0.0082
16	Ariyakottai	TR	1	4	1	3.6	0.526	3.0	83.5	83.5	0.0063
17	Urappuli (E)	TR	1	6	1	3.3	1.354	4.0	142.8	194.1	0.0095
18	Kattuparamakudi (E)	TR	1	4	1	2.7	1.671	3.0	284.0	179.7	0.0059
19	Landai	TR	1	1	2	1.8	1.457	5.0	95.1	106.2	0.0153
20	Kooriyur	TR	1	6	1	1.2	0.730	1 week	183.8	190.7	0.0040
21	Ramnad Big Tank (E)	TR	4	8	3	2.4	17.502	5.0	1632.4	1630.4	0.0107

Note: (E) = Extended system; C = Chain; I = Isolated; Na = Not available; Column 7: Depth at the deepest sluice of the tank; HR = Head reach; MR = Middle reach; TR = Tail-
Column 9: As per farmer's experience (approximate). The figures show the duration of supply available only at FTL, it does not take into account the no of fillings in a

Source: Memoirs, VAO records and group interviews held with the *ayacutdars* of respective tanks.

(*Ayacut* in Hectares)

Water spread a (WSA) ctares)	WSA/ *ayacut* (13/10) (hetctares)	Average depth (8X100/13) (metres)	Free catchment area (sq km)		Greatest width of WSA (metres)	Length of *bund* (metres)	Max. flood discharge (cu sec)	Total length of main channels (km)	Class of tank	Single/ double crop (S/D)	Isolated/ chain/ (E)
			Total	Per hetctares of *ayacut* (16/10)							
13	14	15	16	17	18	19	20	21	22	23	24
48.3	1.9	0.5	4.58	0.0597	645	1,500	936	4.0	III	S	C
64.8	0.4	0.8	2.98	0.0187	100	500	1,341	2.8	IV	S	I
77.7	0.4	0.5	4.30	0.0199	530	850	537	3.2	IV	S	C
Na	Na	Na	Na	Na	200	1,500	Na	0.8	III	S	C
70.2	1.9	0.6	4.12	0.0467	200	1,730	3,160	5.5	III	S	C
260.6	2.1	0.4	7.41	0.0589	880	2,500	1,286	4.0	III	S	E
87.1	0.9	1.1	2.33	0.0250	950	2,300	700	5.0	III	S	E
52.6	0.5	2.0	3.11	0.0301	110	1,460	1,184	4.0	IV	S	C
05.2	0.4	0.8	1.61	0.0062	1,000	2,600	570	9.0	IV	S	I
13.1	0.1	0.9	0.28	0.0032	200	1,100	185	5.0	IV	S	C
54.5	0.6	1.8	1.30	0.0138	880	1,500	930	2.5	III	S	E
78.9	0.6	1.0	7.12	0.0546	400	1,400	693	2.3	III	S	E
114.9	4.9	0.1	3.57	0.0424	730	1,950	1,792	8.5	IV	S	C
76.3	1.9	0.5	0.91	0.0099	1,000	3,150	158	4.5	III	S	C
236.0	2.1	0.4	4.04	0.0360	1,850	2,690	42	3.0	III	S	C
69.1	0.8	0.8	3.73	0.0447	1,000	2,850	1,162	3.4	III	S	C
61.2	1.1	0.8	2.43	0.0171	2,000	3,350	356	9.0	III	S	E
82.8	0.6	0.9	4.22	0.0149	4,000	3,292	1,320	11.0	III	S	E
74.5	1.8	0.8	9.84	0.1035	2,000	4,600	1,050	3.0	III	S	I
102.4	0.6	0.7	2.12	0.0116	200	2,150	415	11.0	IV	S	C
154.7	0.9	1.2	21.34	0.0131	2,376	10,050	6,613	16.0	III	S	E

s of tanks: < 3 months = class IV; 3–6 months = class III; 6–9 months = class II; > 9 months class I. (For more details see GO 2501 PWD, GOM, 3-6-1914).
A: water spread area

Table A3.3: Conditions of Physical Structures in the Periyar-Vaigai System Tanks, 1995

Tank serial no	Inlet channel			Tank *bund*			tankbed				Sluices and control structures				Surplus weir			
	Good	Encro-ached	Silted	Good	Breached	Depressed	Total depth (metres)	Siltation		Encroach-ment	Total No	Good	Damaged	No shuters	Total No	Good	Weak	Breached
					Number of locations			Heavy	Not much									
Head-reach tanks																		
1	No	No	Yes	Yes	No	No	0.9	No	0.3	No	4	3	1	0	1	0	1	0
2	Yes	No	No	Yes	No	No	2.1	1.2	No	No	8	8	0	0	1	1	0	0
3	No	Yes	No	No	2	4	2.4	1.2	No	No	6	4	2	0	2	0	0	2
4	No	Yes	No	Yes	No	No	3.3	No	0.9	No	2	2	0	0	2	0	2	0
5	Yes	No	No	No	3	Many	3.3	No	0.6	No	3	0	3	3	2	0	2	0
6	No	Yes	No	Yes	No	No	2.7	No	0.6	No	1	1	0	0	1	1	0	0
Middle-reach tanks																		
7	No	Yes	Yes	Yes	No	No	1.2	0.6	No	No	2	0	2	0	1	1	0	0
8	No	Yes	No	No	2	1	2.4	1.2	No	No	4	0	4	4	1	1	0	0
9	Yes	No	No	No	2	No	2.7	No	0.6	No	5	3	2	0	2	2	0	0
10	No	No	Yes	No	1	Many	1.5	0.9	No	No	2	0	2	0	1	1	0	0
11	Yes	Yes	No	No	2	3	2.1	1.2	No	Yes	4	0	4	0	1	1	0	0
12	Yes	No	No	No	1	4	2.4	1.2	No	No	3	3	0	0	1	1	0	0
Tail-reach tanks																		
13	No	Yes	Yes	No	2	Many	3.9	1.8	No	No	3	1	2	0	4	3	1	0
14	Yes	No	No	No	1	Many	3.0	No	0.6	No	4	0	4	0	1	0	0	1
15	Yes	No	No	No	No	Many	3.0	No	0.9	No	3	3	0	0	1	0	0	1

Note: Not much siltation = depth of silt is upto 40 per cent at its deepest sluice. Deposited silt can be removed easily if necessary steps are taken by the government. Heavy siltation = depth of silt is above 40 per cent at its deepest sluice. It is very difficult to remove the silt manually. Only machine power can do the operation.

Source: Field visit and interviews held with village elders, knowledgeable persons and *thalaiyaries*, 1995.

Table A3.4: Conditions of Physical Structures in the Periyar-Vaigai Non-System Tanks, 1995

Tank Serial No	Inlet channel			Tank *bund*			Tankbed				Sluices and control structures				Surplus weir			
	Good	Encro-ached	Silted	Good	Breached	Depressed	Total depth (metres)	Siltation		Encroach-ment	Total No	Good	Damaged	No of shutters	Total No	Good	Weak	Brea-ched
					Number of locations			Heavy	Not much									
Head-reach tanks																		
1	No	Yes	Yes	No	2	5	3.0	No	0.9	No	3	0	3	0	2	0	0	2
2	No	No	No	No	1	1	2.4	1.5	No	No	3	0	3	3	2	0	0	2
3	No	Yes	Yes	No	1	2	3.3	No	0.9	No	2	0	2	2	1	0	1	0
4	No	No	Yes	Yes	No	No	2.4	1.5	No	No	2	0	2	2	1	1	0	0
5	No	Yes	No	Yes	No	No	4.8	2.1	No	No	3	3	0	0	2	1	1	0
6	No	Yes	No	Yes	No	No	2.7	No	0.6	No	3	0	3	0	3	1	0	2
Middle-reach tanks																		
7	No	Yes	Yes	No	3	4	3.3	No	0.9	No	2	2	0	0	1	0	1	0
8	No	Yes	Yes	No	1	3	3.3	No	0.9	No	4	2	2	0	2	0	2	0
9	No	Yes	No	No	2	3	1.8	No	0.6	No	5	0	5	5	1	0	0	1
10	No	No	Yes	Yes	No	No	3.3	1.8	No	No	4	0	4	4	1	0	1	0
11	No	No	Yes	No	1	3	4.2	1.8	No	70 Acres	5	2	3	0	2	2	0	0
12	No	Yes	Yes	No	2	Many	3.0	No	0.6	20 Acres	4	0	4	0	1	1	0	0
Tail-reach tanks																		
13	Yes	No	No	Yes	No	No	2.1	1.2	No	No	4	0	4	4	1	0	1	0
14	No	yes	No	No	1	Many	2.4	1.5	No	No	5	0	5	5	1	1	0	0
15	No	No	Yes	No	2	2	3.3	1.8	No	No	4	0	4	4	3	3	0	0
16	No	Yes	Yes	No	1	Many	3.6	1.5	No	No	4	0	4	4	1	1	0	0
17	No	No	Yes	No	1	Many	3.3	no	1.2	No	6	6	0	0	1	1	0	0
18	No	Yes	Yes	No	2	Many	2.7	1.5	No	No	4	0	4	4	1	1	0	0
19	No	No	No	No	1	2	1.8	0.9	No	No	1	0	1	1	2	0	0	2
20	No	Yes	Yes	No	1	Many	1.2	0.6	No	No	6	2	4	4	1	0	0	1
21	No	Yes	Yes	No	2	Many	2.4	1.2	No	No	8	5	3	0	3	3	0	0

Note: Not much siltation = Depth of silt is upto 40 per cent at its deepest sluice. Deposited silt can be removed easily if necessary steps are taken by the government. Heavy siltation = Depth of silt is above 40 per cent at its deepest sluice. It is very difficult to remove the silt manually. Only machine power can do the operation.

Source: Field visit and interviews held with village elders, knowledgeable persons and *thalaiyaries*, 1995.

Table A3.5: Conditions of Water Supply in the System Tanks During 1992-93 — 1994-95

Tank al no	Source of supply to the tank	Maximum depth attained (metres)			Duration of supply Available to *ayacut* (months)			Difference in water supply condition between head and tail-reach *ayacut*
		1994-95	1993-94	1992-93	1994-95	1993-94	1992-93	
1	2	3	4	5	6	7	8	9
Head-reach tanks								
1	Othaveedu sluice of PMC. Between III and IV BC of PMC. Offtake at 28th Km 205 metres.	17-6-94 16-2-95	30-6-93 9-3-94	14-7-92 3-3-93	8	8	7	Tail-reach gets excess supply due to seepage even from the beginning
2	15 A new sluice of PMC. Between II and III BC of PMC. Offtake at 17th Km 600 metres.	21-8-94 30-12-94	26-10-93 20-1-94	NA NA	4	3	NA	Only at the last 1 month of crop period tail-enders feel scarcity
3	Thenkarai channel of PMC. 10th sluice offtake.	17-6-94 9-2-95	30-6-93 20-3-94	13-7-92 14-3-93	7	8	8	In the deep sluice, tail–reach non-well farmers felt scarcity in supply
4	Thirumangalam Main Canal (TMC) Offtake at sluice 40 (L).	25-9-94 16-1-95	18-11-93 31-1-94	20-9-92 14-1-93	3.5	3	3.5	None: Main channels are fully lined up.
5	TMC. V BC. Offtake at sluice no 2.	20-9-94 16-1-95	13-11-93 31-1-94	15-9-92 14-1-93	5	4	5	The distance between head and tail *ayacut* is over 1.5 kms. So, supply difference is 15-20 days always.
6	TMC. Offtake at sluice 38 (L).	25-9-94 16-1-95	18-11-93 31-1-94	20-9-92 14-1-93	3.5	3	3.5	No
Middle-reach tanks								
7	9th BC of PMC. Offtake Othakadai dy 3 (L).	17-9-94 NA	NA	NA	3.5	3.5	3.5	No
8	9th BC of PMC. Kunnathur tail br. supply.	17-9-94 NA	NA	NA	4.5	4.5	4.5	No
9	I BC of PMC, 12.08 km Offtake at 24th sluice.	21-8-94 30-12-94	26-10-93 20-1-94	NA	4	3.5	NA	Except the deepest, other sluies are having scarcity problem for a month.
10	9th BC of PMC, Chittampatti offtake. Tirukkanam sluice 1.	17-9-94 NA	NA	NA	4	4	4	No
11	X BC of PMC. Maruthur kye sluice no 1 Chunnambu channel.	12-10-95 NA	NA	NA	4	NA	NA	Only deep sluice *aycutdars* receiving enough supply of water.
12	X BC Tail-end of PMC.	11-9-95 NA	NA	NA	4	NA	NA	No
Tail-reach tanks								
13	Actual source 9th BC of PMC 6th sluice. But no supply was available from the chl. so far.	NIL	NIL	NIL	4	4	3	No
14	12th BC of PMC 48th sluice.	10-1-95 15-1-95	NIL	10-12-93 15-12-93	3	5	4	No
15	12th BC of PMC 48th sluice.	4-10-94 20-10-94	NIL	15-11-93 29-11-93	3	5	4	No

Note: NA = Not available; Nil = No supply available from the PMC (Periyar Main Canal); BC = Branch canal.
Columns 3 to 5: "Water release period" refer to the date of start and end of supply in the relevant channel in that year based on records maintained by the PWD. This does not however indicate volume of water supplied or even the number of days.
Columns 6 to 8: This relates to the duration for which tank water (including yield from catchment and surplus from upstream tanks) was available to the ayacut, based on information provided by informed villagers.
Column 9: Based on information given by knowledgeable farmers.

Source: Date of release of water is taken from PWD section offices which control the tanks, all other details are collected from the village elders, knowledgeable persons of each village served by the tanks, 1995.

Table A3.6: Conditions of Water Supply in the Non-System Tanks During 1992-93 — 1994-95

Tank Sl No	Source of supply to the tank	Depth of tank (metres)	Water release period in the supply channel			Duration of supply available to *ayacut* (months)			Difference in water supply condition between head and tail–reach *ayacut*
			1994-95	1993-94	1992-93	1994-95	1993-94	1992-93	
1	2	3	4	5	6	7	8	9	10
Head-reach tanks									
1	Manjalar anicut supply	3.0	3.0	3.0	3.0	4	4	3	Only well farmers can cultivate under elevated sluice even at FTL.
2	Nagamalai catchment supply	2.4	2.4	2.4	2.4	3	3	3	No
3	Manjalar anicut supply	3.3	3.3	1.8	0.0	4	1.5	0	Only well farmers can cultivate under elevated sluice even at FTL.
4	Varattar river supply	2.4	1.5	2.4	2.4	1	3	3	No
5	Local hills/catchment supply	4.8	3.0	3.0	1.8	1.5	1.5	0.5	Difference between deep and elevated sluice supply is 15 days.
6	Thirumangalam Extension Main Canal Supply (TEMC)	2.7	2.7	2.7	2.7	4	3	4	No
Middle-reach tanks									
7	Nilayur BC supply take-off from Vaigai Reservoir system	3.3	3.0	3.3	3.3	4	4.5	4.5	No
8	Upper tank surpluses available through 'Odai'	3.3	1.5	2.1	1.5	0.5	1	0.5	No All are lined channels.
9	Vaigai river direct supply	1.8	No supply to the tank for the past 20 years.						
10	Catchment + local palar river supply	3.3	3.3	3.3	3.3	4	5	5	Elevated sluice ayacutdars get 20 days less supply in a season.
11	Periyar Extension Main Canal Supply (PEMC)	4.2	4.2	4.2	4.2	5	5	5	No
12	Catchment supply + 6th BC of PEMC	3.0	1.5	3.0	3.0	2	5	5	No
Tail-reach tanks									
13	Only catchment supply	2.1	2.1	2.1	2.1	4	4	4	No
14	Manimuthar river diversion	2.4	0.9	2.4	0.6	0.3	3	NIL	Difference between deep and elevated sluice supply is 20 days.
15	Odai + Catchment supply	3.3	3.3	3.3	3.3	6	7	7	Difference between deep and elevated sluice supply is 10 days.
16	Upper Nattar Kal	3.6	3.6	3.6	3.6	5	6	6	Difference between deep and elevated sluice supply is one month.
17	Right Bank Canal (RBC) from the Vaigai river. Take-off from 22.12 km of RBC	3.3	2.7	2.4	2.7	4	4	4	Difference between deep and elevated sluice supply is two months.
18	RBC from the Vaigai river Take-off from 14.62 km of RBC	2.7	2.7	2.7	2.7	6	6	3	Difference between deep and elevated sluice supply is 15 days.
19	Only catchment supply	1.8	1.8	1.8	1.5	5	5	4	No
20	Supply from the 7th sluice of Ramnad Big Tank	1.2	1.2	1.2	1.2	5	6	6	No
21	Vaigai River Supply. Tail-end	2.4	2.4	2.4	2.4	5	7	7	Difference between deep and elevated sluice supply is 1.5 months.

Note: Nil represents available limited supply was not used.

Source: Depth of tank storage (measured at the deepest sluice) is taken from PWD section offices which control the tanks-all other details are collected from the village elders, knowledgeable persons of each village served by the tanks, 1995.

Table A3.7: Functioning of Irrigation Organisation in the Periyar-Vaigai System Tanks, 1994-95

Tank Sl No	No of functionaries and caste			Total land owned (hectares)	Method of selection & period		Main duties	Remuneration/hectare/person/season	
	No	Type	Caste		Method	Period		*Neerkatties*	*Thotties*
1	2	3	4	5	6	7	8	9	10
Head-reach tanks									
1	1	*Thotti*	Pr	1.0	Hy	Pt	SO + VD	–	3.7M
2	4	*Madaiyan*	Pn	–	Hy	Yr	SO + MG	1.2M	–
	1	*Thotti*	Pr	–	Hy	Yr	Emergency works + LM	–	0.6M
3	1	*Madaiyan*	Pn	–	Hy	Yr	SO + Divert water to main madai from the chl.	2.5 Mi	–
	2	*Thotti*	Cn+Pr	–	Hy	Yr	LM + VD + Helping Madaiyans	–	1.2 Mi
4	–	–	–	–	–	–	irrigation works	–	–
5	–	–	–	–	–	–	are done by farmers	–	–
6	–	–	–	–	–	–	themselves	–	–
Middle-reach tanks									
7	2	*Thotti*	Pr	1.0	Hy	Yr	Petty irrigation works + VD + MG	–	3.7M
8	1	*Thotti*	Cn	–	Hy	Yr	Petty irrigation works + VD	–	2.5M
9	2	*Madaiyan*	Pn	0.8	Hy	Yr	SO + MG	2.5M	–
	2	*Thotti*	Pr	–	Hy	Yr	LM + VD	–	1.2M
10	3	*Thotti*	Pr	–	Hy	Yr	VD + Helping the farmers for irrigation works	–	Rs 150/month
11	1	*Thotti*	Pr	–	Hy	Yr	SO + LM +VD	–	Rs 200/month
12	1	*Lascar*	Govt emplo.	–	Permanent		Only SO.	Rs 1800/ month	–
Tail-reach tanks									
13	2	*Kaval*	Dobi + Kallar	1.7	TSA	2 months	SO + Protecting crop from cattle and thives	–	Rs 250/month
14	2	*Neer-paichi*	Vala-yars	2.4	TSA	3 months	SO + Irrigating ayacut in all periods for about 4 months.	Rs 1200/ month	–
15	2	Sluice operator	Kallar	5.0	TSA	3 months	SO. 6 am to 6 pm daily for 4 months	Rs 900/ month	–

Note: 1 *Marakkal* (M) = 4.5 Kg of paddy; 1 *Mandai* (Mi) = 3 Kg of paddy; – indicates nil.
SO = Sluices operation. VD = Village duties. MG = Measuring grains for each farmer; LM = Local Messenger.
Pr = *Parayan;* Pn = *Pallan;* Cn = *Chakkilian;* Pt = Permanent; Yr = Yearly rotation.
TSA = Temporarily selected by the *ayacutdars;* Hy = Hereditary; Chl = Channel
Numbers as given in columns 9 and 10 show the extent of remuneration given in marakkal (of paddy) as reported by *neerkatties* and *thotties.*
Remuneration is given for all crops including annual crops, in Tank No 3. For all other tanks it is paid only for paddy.
Source: Group interviews held with village elders, knowledgeable persons and *thalaiyaries,* 1995.

Table A3.8: Functioning of Irrigation Organisation in the P-V Non-system Tanks, 1994-95

Tank Sl. No	No of functionaries and caste			Total land owned (hectares)	Method of selection & period		Main duties	Remuneration/hectare/person/season	
	No	Type	Caste		Method	Period		*Neerkatties*	*Thotties*
1	2	3	4	5	6	7	8	9	10
Head-reach tanks									
1	1	*Neerkatti*	Govt. emplo.	–	Hy	Pt	SO + Help farmers to approach officials to solve local problems.	Rs 1400/ month + 2.5M	–
2	1	*Madaiyan*	Pr	2.0	Hy	Yr	SO + Supervision of surplus weir	2.5M	–
	2	*Thotti*	Pr	–			LM + VD	–	2.5M
3	2	*Neerpaichi*	Pr+Cn	–	Hy	Yr	SO + IAA + EW + LM	3.7M	–
4	1	*Madai-kudumpan*	Pn	1.0	Hy	Yr	Only SO.	2.7M	–
	1	*Kaval*	Thevar	–	TSA	1 season	PCCT	–	2.2M
5	2	*Madaiyan*	Pn	–	Hy	Yr	SO + Supervising supply to the tank.	4.4M	–
	2	*Kaval*	Pr+Sr	–	Hy	Yr	PCCT	–	3.3M
	1	*Thotti*	Pr	–	Hy	Yr	LM + VD	–	3.3M
6	2	*Madaiyan*	Pn+Cn	–	Hy	Yr	SO + IADSP	2.5M	–
Middle-reach tanks									
7	1	*Madaiyan*	Pn	–	Hy	Yr	Only SO	2.5M	–
	1	*Thotti*	Pr	0.5	Hy	Yr	LM + VD	–	1.2M
8	1	*Thotti*	Cn	–	Hy	Yr	Organise ayacutdars for Kudimaramat + Supervision of tank structures.	–	3.7M
9	1	*Thotti*	Pr	–	Hy	Yr	No supply for the past 20 years.	–	–
10	1	*Neerpaichi*	Pn	–	Hy	Yr	SO + IAA	3.7M	–
11	3	*Neerpaichi*	Pn	1.0	Hy	Yr	SO + IAA Supervision of tank structures.	2.5M	–
12	–	–	–	–	–	–	All irrigation works are done by farmers themselves	–	–
Tail-reach tanks									
13	–	–	–	–	–	–	All irrigation works are done by farmers themselves	–	–
14	3	*Neerpaichi*	Vala-yars	1.4	TSA	1 season	SO + IAA	3.7M	–
15	1	*Madai-variyan*	Pn	0.5	Hy	Yr	SO + Supervision of surplus weir	2.5M	–
	1	*Thotti*	Cn	0.5	Hy	Yr	VD + Repairing the *bunds*	–	2.5M
	3	*Neerpaichi*	Pn	2.8	TSA	3 months	IAA	Rs 600/ month	–
16	2	*Setham-Parpavar*	Pn + Nadar Pn	– 1.0	TSA	2 months	SO + IADSP	Rs 170/ month	–
17	2	*Neerpaichi*	Pn	3.0	TSA	1 season	SO + IADSP	2.5M	–
	2	*Thotti*	Cn	–	Hy	Yr	VD + Repairing the *bunds*	–	1.9M
18	2	*Kaval*	Vala-yar+Pn	2.0 2.0	TSA	2 months	SO + IADSP	–	Rs 1200/ month

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Continued A3.8

Tank Sl No	No of functionaries and caste			Total land owned (hectares)	Method of selection & period		Main duties	Remuneration/hectare/person/season	
	No	Type	Caste		Method	Period		*Neerkatties*	*Thotties*
1	2	3	4	5	6	7	8	9	10
19	1	*Madai-variyan*	Yadava	–	TSA	3 months	Only SO.	0.8M	–
	4	*Neerpaichi*	Pn	5.5	TSA	3 months	IADSP	0.8M	–
20	–	–	–	–	–	–	All irrigation works are done by farmers themselves	–	–
21	3	*Lascar*	Govt. emplo.	–	Permanent		Management of tank structures + IAA + SO + PCCT	Rs 2500 + / month	–
	3	*Kaval*	Pn	1.5	TSA	1 season		–	1.2 M

Note: 1 *Marakkal* (M) = 4.5 Kg of paddy; 1 *Mandai* (Mi) = 3 Kg of paddy; – indicates nil; TSA = Temporarily selected by *ayacutdars;* Pr = *Parayan;* Pn = *Pallan;* Cn = Chakkilian; Sr = Servai; Pt = Permanent; Yr = Yearly rotation; SO = Sluices operation; VD = Village duties. LM = Local Messenger. EW = Emergency works. IADSP = Irrigating *ayacut* during deficit supply period only; IAA = Irrigation *ayacut* in all periods; PCCT = Protecting crop from cattle and thives; * In Ramnad Big tank (sl no 21) out of the four villages, namely, Thoruvalur (572 hectares), Achundan vayal (142 hectares), Soorankottai (458 hectares) and Puthendal and Kooriyur (458 hectares), only the former two villages have assisted irrigation workers. Numbers as given in columns 9 and 10 show the extent of remuneration given in *marakkal* (of paddy) as reported by *Neerkatties* and *Thotties*. Remuneration is given for all crops including groundnut sown in the second season in Tank No 15. Hy = Hereditary; In all other tanks remuneration is paid only for paddy crop.

Source: Group interviews held with village elders, knowledgeable persons and *thalaiyaries,* 1995.

Table A3.9: Contribution of PWD and *Ayacutdars* to Maintenance and Repairs in the Periyar-Vaigai System Tanks, 1990-91 to 1994-95

Tank	Maintenance of inlet channel PWD			Repairs undertaken by the PWD					Repairs done by the *ayacutdars*						
Sl No	No of years work done	Type of work	Amount '000 Rs	Work done by *ayacutdars* (years)	Type of work	No of years work done	Amount '000 Rs	Total amount (4+8) '000 Rs	Type of work	No of years work done	Amount '000 Rs	Total amount (9+12) '000 Rs	Total *ayacut* (hectares)	Amount per hectare (13/14)	Ayacut bution % to total (12/13)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Head-reach tanks															
1.	0	0	0	5	SR	1	35	35	SB	2	15.0	50.0			
2.	0	0	0	5	Nil	Nil	0	0	SB	3	21.0	21.0			
3.	0	0	0	5	SB	1	100	100	SB + SR	1	13.5	113.5			
4.	0	0	0	10	SB	1	63	63	Nil	Nil	0.0	63.0			
5.	0	0	0	5	Nil	Nil	0	0	Nil	Nil	0.0	0.0			
6.	0	0	0	5	SB + SR	1	60	60	SR+RW	2	7.0	67.0			
Total			**0**				**258**	**258**			**56.5**	**314.5**	**632**	**498**	**18**
Middle-reach tanks															
7.	0	0	0	20	Nil	Nil	0	0	SB	2	18.0	18.0			
8.	0	0	0	3	RW	1	150	150	Nil	Nil	0.0	150.0			
					Breach closing and SB	1	30	30				30.0			
9.	2	Special	150	5	FDBR	1	500	650	Nil	Nil	0.0	650.0			
		repair			SB + SR	1	180	180				180.0			
10.	0	0	0	0	FDBR	1	20	20	SR + SB	3	16.0	36.0			
11.	0	0	0	5	Nil	Nil	0	0	Nil	Nil	0.0	0.0			
12.	1	Special	75	5	Desilting tankbed + SB	1	250	325	Nil	Nil	0.0	325.0			
		repair			SR	1	50	50				50.0			
Total			**225**				**1180**	**1405**			**34.0**	**1439.0**	**1013**	**1421**	**2**
Tail-reach tanks															
13.	0	0	0	15	SR	1	48	48	RW+SR	3	5.0	53.0			
14.	1	Lining	500	10	Nil	Nil	0	500	SB + SR	3	14.0	514.0			
		the chl.													
15.	0	0	0	10	SR	1	25	25	SB+RW	3	25.0	50.0			
Total			**500**				**73**	**573**			**44.0**	**617.0**	**443**	**1393**	**7**

Note: SR = Sluices repair/reconstruction; SB = Strengthening of tank *bund*; RW = Reconstruction/repair of weir; FDBR = Flood damaged *bund* reapir.
Source: Interviews held with junior engineers, work inspectors and *lascars* in each section office which controls the tanks, 1995.

Table A3.10: Contribution of PWD and *Ayacutdars* to Maintenance and Repairs in the Periyar-Vaigai Non-system Tanks, 1994-95

Tank	Maintenance of inlet channel PWD			Repairs undertaken by the PWD					Repairs done by the *ayacutdars*						Amount per hectare (13/14)	*Ayacut* contribution % to total (12/13)
Sl No	No of years work done	Type of work	Amount '000 Rs	Work done by *ayacutdars* (years)	Type of work	No of years work done	Amount '000 Rs	Total amount (4+8) '000 Rs	Type of work	No of years work done	Amount '000 Rs	Total amount (9+12) '000 Rs	Total *ayacut* hecs			
1	2	3	4	5	6	7	8	9	10	11	12	13	14		15	16
Head-reach tanks																
1.	0	0	0	5	RWC	2	17	17	SR + SB	3	15.0	32.0				
2.	0	0	0	nil	Nil	Nil	0	0	Nil	Nil	0.0	0.0				
3.	1	Silt clearence	20	1	SB + SR	1	20	40	SB	1	5.0	45.0				
		(SC)				1	15	15				15.0				
4.	0	0	0	nil	Breach closing and SB	1	90	90	SR + SB	2	2.8	92.8				
5.	1	RWC	35	3	SR	1	70	105	Nil	Nil	0.0	105.0				
6.	0	0	0	5	SB	1	30	30	Nil	Nil	0.0	30.0				
Total			**55**				**242**	**297**			**22.8**	**319.8**	**678**		**472**	**7**
Middle-reach tanks																
7.	2	SC+RWC	115	10	DTB + SR	2	95	210	SR + SB	3	25.5	235.5				
8.	1	SC	20	5	SB + RW +RWC	3	70	90	SR + SB	3	6.8	96.8				
9.	1	SC (1995)	300	0	Nil	Nil	0	300	Nil	Nil	0.0	300.0				
10.	0	0	0	10	SB + SR	2	60	60	Korambu construction	5	30.0	90.0				
11.	0	0	0	5	SB	1	20	20		4	40.0	60.0				
12.	0	0	0	3	SB +RW + RWC	3	55	55	SR + SB	3	39.0	94.0				
Total			**435**				**300**	**735**			**141.3**	**876.3**	**768**		**1141**	**16**
Tail-reach tanks																
13.	0	0	0	5	Nil	Nil	0	0	SR + RAP	4	28.0	28.0				
14.	0	0	0	5	Nil	Nil	0	0	SR + SB	2	23.0	23.0				
15.	0	0	0	10	Nil	Nil	0	0	SR	1	2.0	2.0				
16.	0	0	0	1	SB + SR + Earth work	2	122	122	RAP	3	5.0	127.0				
17.	0	0	0	5	SR	1	55	55	SR + SB	4	30.0	85.0				
18.	0	0	0	10	SB + SR + RW	3	87.5	87.5	RAP+SB+SR	3	48.0	135.5				
19.	0	0	0	nil	SB + RW	2	41	41	RAP + SB	4	19.0	60.0				
20.	0	0	0	4	Nil	Nil	0	0	Nil	Nil	0.0	0.0				
21.	5	Maintenance	50	1	Filling of rain gulleys	5	250	300	SB+SR+NRCD	3	35.0	335.0				
					(10Kms) + RW (2 Nos.)	2	119.5	119.5		1	12.0	131.5				
Total			**50**				**675**	**725**			**202.0**	**927.0**	**2688**		**345**	**22**

Note: In Nariyankudi tank (no 14) during 1992-93 an amount of Rs 99,000 was sanctioned for maintenance.
But due to the contractor's inefficiency the work was not carried out till 1995; SC = Silt clearence; RWC = Retaining wall construction.; DTB = Desilting tankbed.
RAP = Removal of *adalai* plants in the tankbed; SR = Sluices repair/reconstruction; SB = Strengthening of tank *bund*; RW = Reconstruction/repair of weir;
NRCD = Northern regulator channel is fully desilted.

Source: Interviews held with junior engineers, work inspectors and *lascars* in each section office which control the tanks, 1995.

Table A3.11: *Ayacutdars'* Contribution to Maintenance and Repairs in the Periyar-Vaigai System Tanks, 1994-95

Tank Sl No	Type of channel A. Inlet B. Main/ branch C. Field	No of times work done during last 5 years	Details of work done in 1994-95									Length of channels (km)	*Ayacut* (acres)	Col 9/14	Total contribution per acre of *ayacut* (Rs)
			No of times work done	Labour humandays			Rate of labour/ day	Total contribution (Rs)	Extent of participation (%)	Basis of contribution Acre/HH	Penalty day (Rs)				
				Own	Hired	Total									
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Head-reach tanks															
1	A	5	1	0	300	300	40	12,000	100	Acre	40	3.0	197.8	61	110
	B	10	2	0	125	125	40	5,000	100	Acre	40	3.0		25	
	C	10	2	120	0	120	40	4,800	100	–	–	NA		24	
2	A	5	1	150	250	400	30	12,000	100	Acre	30	5.0	337.7	36	64
	B	5	1	100	75	175	30	5,250	100	Acre	30	9.0		16	
	C	5	1	140	0	140	30	4,200	100	–	–	NA		12	
3	A	5	1	15	20	35	30	1,050	75	*	–	1.0	520.0	2	28
	B	10	2	100	100	200	30	6,000	100	Acre	–	8.0		12	
	C	10	2	2	50	0	250	30	7500	100	–	–	NA		14
4	A	10	2	0	100	100	40	4,000	60	HH	–	2.0	158.4	25	53
	B	5	1	30	20	50	40	2,000	100	*1	–	2.0		13	
	C	5	1	60	0	60	40	2,400	100	*1	–	NA		15	
5	A	5	1	75	0	75	30	2,250	80	–	–	1.0	278.5	8	32
	B	5	1	120	0	120	30	3,600	100	–	–	3.5		13	
	C	5	1	100	0	100	30	3,000	100	–	–	NA		11	
6	A	5	1	25	0	25	30	750	100	HH	–	1.0	54.3	14	52
	B	10	2	50	0	50	30	1,500	100	–	–	2.0		28	
	C	5	1	20	0	20	30	600	100	–	–	1.0		11	
Middle-reach tanks															
7	A	20	4	0	40	40	40	1,600	40	*2	–	1.0	101.1	16	30
	B	5	1	10	5	15	40	600	60	*2	–	1.0		6	
	C	5	1	20	0	20	40	800	80	*2	–	1.0		8	
8	A	3	1	50	0	50	30	1,500	100	HH	–	1.0	280.9	5	14
	B	5	1	50	0	50	30	1,500	100	HH	–	3.5		5	
	C	5	1	35	0	35	30	1,050	100	HH	–	NA		4	
9	A	5	1	120	30	150	50	7,500	60	Acre	50	3.0	676.0	11	55
	B	5	1	350	50	400	50	20,000	100	–	–	10.0		30	
	C	5	1	200	0	200	50	10,000	100	–	–	NA		15	
10*3	A	0	0	0	0	0	0	0	0	–	–	2.0	169.0	0	28
	B	5	1	15	20	35	50	1,750	30	–	–	2.5		10	
	C	5	1	60	0	60	50	3,000	80	–	–	NA		18	
11	A	5	1	50	0	50	50	2,500	80	Acre	–	3.5	326.9	8	49
	B	5	1	120	60	180	50	9,000	100	Acre	–	6.5		28	
	C	5	1	90	0	90	50	4,500	100	–	–	NA		14	
12	A	5	1	30	0	30	50	1,500	50	Acre	–	1.5	969.0	2	7
	B	5	1	40	20	60	50	3,000	80	Acre	–	4.0		3	
	C	5	1	40	0	40	50	2,000	100	–	–	NA		2	

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Tank Sl No	Type of channel A. Inlet B. Main/ branch C. Field	No of times work done during last 5 years	Details of work done in 1994-95									Length of channels (km)	*Ayacut* (acres)	Col 9/14	Total contribution per acre of *ayacut* (Rs)
			No of times work done	Labour mandays			Rate of labour/ day	Total contribution (Rs)	Extent of participation (%)	Basis of contribution Acre/HH	Penalty day (Rs)				
				Own	Hired	Total									
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Tail-reach tanks															
13	A	15	3	450	0	450	30	13,500	100	HH	–	3.0	198.6	68	144
	B	10	2	300	0	300	30	9,000	100	HH	–	4.5		45	
	C	5	1	200	0	200	30	6,000	100	HH	–	NA		30	
14	A	10	2	400	0	400	30	12,000	100	Acre	20	5.0	217.4	55	131
	B	10	2	300	0	300	30	9,000	100	Acre	20	5.0		41	
	C	5	1	250	0	250	30	7,500	100	–	–	NA		34	
15	A	10	2	200	0	200	30	6,000	100	Acre	30	6.0	416.5	14	40
	B	10	2	200	0	200	30	6,000	100	Acre	30	4.0		14	
	C	5	1	150	0	150	30	4,500	100	–	–	NA		11	

Note: Money contribution relates only to hired labour; — indicates Nil; HH = Household.
*Amount collected from Magimai (Oor Kuthagai), duck rearing, sand sales are utilised for this purpose.
*1 Farmers themselves individually contributed the amount.
*2 Problem-facing farmers only contributed the amount.
*3 This tank *ayacutdars* are getting water supply illegally from 10th BC of PMC, (which passes close to the tank) instead of their actual right of the channel supply from 9th BC of PMC. This requires no maintenance of inlet channel.
Source: Group interviews held with village elders, knowledgeable persons and *thalaiyaries,* 1995.

Table A3.12: *Ayacutdars'* Contribution to Maintenance and Repairs in the Periyar-Vaigai Non-System Tanks, 1994-95

Tank Sl No	Type of channel A. Inlet B. Main/ branch C. Field	No of times work done during last 5 years	Details of work done in 1994-95									Length of channels (km)	*Ayacut* (acres)	Col 9/14	Total contribution per acre of *ayacut* (Rs)
			No of times work done	Labour mandays			Rate of labour/ day	Total contribution (Rs)	Extent of participation (%)	Basis of contribution Acre/HH	Penalty day (Rs)				
				Own	Hired	Total									
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Head-reach tanks															
1	A	5	1	0	200	200	50	10,000	100	Acre	60	6.0	189.8	53	287
	B	5	1	0	800	800	50	40,000	100	Acre	60	4.0		211	
	C	5	1	90	0	90	50	4,500	100	–	–	NA		24	
2	A	No inlet channel.											393.0	0	21
	B	10	2	150	0	150	30	4,500	100	–	2	2.8		11	
	C	10	2	120	0	120	30	3,600	100	–	–	NA		9	
3	A	1	1	0	17	17	40	680	60	Acre	–	2.0	533.9	1	19
	B	2	1	150	0	150	40	6,000	100	–	–	2.2		11	
	C	2	1	80	0	80	40	3,200	100	–	–	NA		6	
4	A	No inlet channel.											215.0	0	20
	B	5	1	0	60	60	35	2,100	100	HH	*	6.5			10
	C	5	1	60	0	60	35	2,100	100	HH	–	NA			10
5	A	3	1	150	0	150	30	4,500	100	Acre	–	2.5	218.0	21	55
	B	5	1	150	0	150	30	4,500	100	Acre	–	5.5		21	
	C	5	1	100	0	100	30	3,000	100	–	–	NA		14	
6	A	5	1	0	25	25	30	750	100	Acre	30	1.5	310.8	2	38
	B	5	1	240	0	240	30	7,200	100	–	–	4.0		23	
	C	5	1	130	0	130	30	3,900	100	–	–	NA		13	
Middle-reach tanks															
7	A	10	2	0	240	240	30	7,200	70	*1	–	10.0	230.4	31	68
	B	10	2	100	100	200	30	6,000	100	–	–	5.0		26	
	C	10	2	80	0	80	30	2,400	100	–	–	NA		10	
8	A	5	1	350	80	430	30	12,900	100	HH	–	5.0	255.0	51	91
	B	10	2	200	0	200	30	6,000	100	–	–	4.0		24	
	C	10	2	140	0	140	30	4,200	100	–	–	NA		16	
9	A	No supply was available for the past 20 years.											643.0		
	B	No maintenance has been done.													
	C														
10	A	10	2	400	200	600	30	18,000	60	Acre	30	2.0	220.0	82	143
	B	5	1	42	110	152	30	4,560	60	–	–	5.0		21	
	C	5	1	300	0	300	30	9,000	100	–	–	NA		41	
11	A	5	1	100	30	130	30	3,900	100	50/Kuli	–	8.0	231.0	17	27
	B	5	1	0	0	0	0	0	–	Contract	–	2.5		0	
	C	5	1	80	0	80	30	2,400	100	–	–	NA		10	
12	A	3	1	300	0	300	30	9,000	100	*2	10	4.0	322.0	28	58
	B	5	1	200	0	200	30	6,000	100	–	20	2.3		19	
	C	5	1	120	0	120	30	3,600	100	–	–	NA		11	

Continued

Continued A3.12

Tank Sl No	Type of channel A. Inlet B. Main/ branch C. Field	No of times work done during last 5 years	Details of work done in 1994-95									Length of channels (km)	*Ayacut* (acres)	Col 9/14	Total contribution per acre of *ayacut* (Rs)
			No of times work done	Labour mandays			Rate of labour/ day	Total contribution (Rs)	Extent of participation (%)	Basis of contribution Acre/HH	Penalty day (Rs)				
				Own	Hired	Total									
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Tail-reach tanks															
13	A	5	1	300	0	300	30	9,000	100	HH	5	1.5	208.1	43	130
	B	5	1	300	0	300	30	9,000	100	HH	15	8.5		43	
	C	5	1	300	0	300	30	9,000	100	–	–	NA		43	
14	A	5	1	500	0	500	30	15,000	100	–	40	3.5	226.2	66	172
	B	5	1	500	0	500	30	15,000	100	–	40	4.5		66	
	C	5	1	300	0	300	30	9,000	100	–	–	NA		40	
15	A	10	2	400	120	520	50	26,000	100	Acre	100	10.0	277.3	94	148
	B	10	2	100	100	200	50	10,000	100	Acre	100	3.0		36	
	C	5	1	100	0	100	50	5,000	100	–	–	NA		18	
16	A	1	1	100	0	100	30	3,000	100	Acre	25	3.0	206.2	15	42
	B	10	2	100	0	100	30	3,000	100	Acre	25	3.5		15	
	C	10	2	90	0	90	30	2,700	100	–	–	NA		13	
17	A	5	1	600	240	840	50	42,000	100	HH	–	6	352.6	119	275
	B	10	2	600	0	600	50	30,000	100	–	–	9		85	
	C	10	2	500	0	500	50	25,000	100	–	–	NA		71	
18	A	10	2	300	200	500	50	25,000	100	Acre	50	3.5	701.4	36	86
	B	5	1	200	200	400	50	20,000	100	Acre	50		11.0	29	
	C	5	1	300	0	300	50	15,000	100	–	–	NA		21	
19	A	No inlet channel.											234.8	0	64
	B	5	1	140	60	200	50	10,000	100	HH	50	3		43	
	C	5	1	100	0	100	50	5,000	100	–	–	NA		21	
20	A	4	1	100	0	100	30	3,000	100	*2	–	1	453.9	7	43
	B	4	1	300	0	300	30	9,000	100	–	–	11		20	
	C	4	1	250	0	250	30	7,500	100	–	–	NA		17	
21	A	1	1	300	0	300	30	9,000	60	*4	–	1.5	4032.0	2	60
	B *3	3	1	7,200	0	7200	30	2,16,000	80	–	–	39		54	
	C	3	1	500	0	500	30	15,000	100	–	–	NA		4	

Note: Money contribution relates only to hired labour.
– Indicates nil.
* If a farmer has not participated he will not be permitted to get the tank supply.
* 1 Amount is raised through interest and it is paid by getting the fish contract amount.
* 2 No compulsory collection. According to the *ayacutdars* paying capacity.
* 3 In RBT there are 8 sluices available.In each sluice on the average 300 persons are engaged for 3 days to complete the entire maintenance work.
* 4 There are 4 revenue villages served by the tank. Each village has to contribute Rs 2,000 to the general fund for tank management purposes.
(E) = Extended system; HH = Household.

Source: Group interviews held with village elders, knowledgeable persons and *thalaiyaries*, 1995.

Table A3.13: Fund Management Under the Periyar-Vaigai System Tanks, 1994-95

Tank Sl No	Funds maintained by organisations (1995)		
	Reserve amount (Rs) TL/VL	Sources of fund collection	Purpose of utilisation
1	2	3	4
Head-reach tanks			
1	Nil	Acreage basis Rs 20-40/acre.	Inlet, main channels maintenance and petty repairs in the tank.
2	VL 40,000	"Magimai", Fish contract and acreage collection.	I.channel maintenance, *bund* strengthening, petty repairs of sluices, village exp.
3	VL 15,000	"Magimai", duck rearing,sale of sand.	————> do <————
4	VL 50,000	Fish contract, household basis of fund collection	Village development, tank repair and inlet channel maintenance.
5	Nil	HH basis of collection	No work has been done for the past 5-7 years except inlet channel maintenance.
6	Nil	HH basis of collection, fish contract.	Village development, tank repair and inlet channel maintenance.
Middle-reach tanks			
7	Nil	Only problem-facing *ayacutdars* contribute the amount to do any work.	Inlet channel maintenance, *bund* strengthening.
8	Nil	HH basis of collection Rs 10-20 per HH.	Only labour contribution no fund is used for tank improvement purpose.
9	VL 10,000	Fish contract, Adavumurai, acreage basis of collection.	Village development, inlet channel maintenance.
10	Nil	Nil	Only labour contribution no fund is used for tank improvement purpose.
11	Nil	Nil	<———— do ————>
12	VL 10,000	Fish contract, big farmers liberal contribution. petty tank repairs.	Inlet channel maintenance,
Tail-reach tanks			
13	Nil	Instant fund collection on HH basis.	Inlet channel maintenance, shutters repair, surplus weir strengthening.
14	VL 5,000	Fish contract, acreage basis of fund collection Rs 25-50/ acre.	Inlet channel maintenance, *bund* strengthening, sluice repair.
15	VL 10,000	Fish contract, acreage basis of fund collection.	Inlet channel maintenance, *bund* strengthening, weir maintenance.

Note: TL = Tank level;
VL = Village level.

Source: Group interviews held with village elders, knowledgeable persons and Thalaiyaries,1995.

Table A3.14: Fund Management Under the Periyar-Vaigai Non-System Tanks, 1994-95

Tank Sl No	Funds maintained by organisations (1995)		
	Reserve amount (Rs) TL/VL	Sources of fund collection	Purpose of utilisation
1	2	3	4
Head-reach tanks			
1	TL 7,500	Fish contract, acreage basis of fund collection Rs 10-50/ acre.	Tank, village development activities, festival expenses.
2	Nil	Acreage basis Rs 10/ acre.	*Bund*, sluice repair.
3	Nil	<——— do ———>	*Bund*, sluices repair, inlet channel maintenance.
4	Nil	HH basis of collection	Closing of breaches in the tank *bund*, minor repairs of the tank.
5	Nil	Acreage basis. Rs 10-15/ acre.	<——— do ———> But no work is done in recent years.
6	Nil	Acreage basis. Rs 20/ acre.	*Bund*, sluice repair.
Middle-reach tanks			
7	TL 10,000	Fish contract only.	Inlet channel maintenance, *bund* strengthening, minor sluice repair.
8	TL 5,000	HH basis of collection	<——— do ———>
9	Nil	Acreage basis.	No work for the past 20 years.
10	Nil	Acreage basis. Rs 10-100/ acre. Tank *bund* wood sale. Fish auction.	To get supply to the tank Rs 10,000 is given to upstream of Kirungakottai villagers to release enough water + *korambu* construction.
11	Nil	1 *Kuli* (66 cents) Rs 50. Membership fee of IB is Rs 20. Fish contract Rs 5000/ year.	Inlet channel maintenance, *bund* strengthening, minor sluice repair, representations to the PWD.
12	Nil	Collection is based on ability to pay by the *ayacutdars*.	Inlet channel maintenance, *bund* strengthening, minor sluice repair.
Tail-reach tanks			
13	Nil	HH basis of collection Rs 10/ hh.	Minor repairs in sluices. 400 HHs.
14	Nil	*Prosopis juliflora* contract Rs 25,000 — once in three years.	Drinking water purpose, *bund* strengthening, minor sluice repair.
15	TL 10,000	Acreage basis. Rs 100/acre. Fish contract.	Inlet channel maintenance, *bund* strengthening, minor sluice repair.
16	VL 35,000	Liberal contribution by big farmers, acreage basis of collection, village fund is also used.	Inlet channel maintenance, *bund*, sluice repair.
17	TL 30,000	*Prosopis juliflora* and fish lease.	<——— do ———>
18	Nil	Acreage basis. Rs 50/acre. Fish contract Rs 10,000–20,000.	Sluice repair, salary to *kaval* persons, *bund* strengthening.
19	Nil	Total HHs = 110. Re. 1/week/HH. 1994 collection was about Rs 4,000.	*Bund*, sluices repair, removal of bushes in the main channels.
20	Nil	According to the payable capacity of *ayacutdars* fund is collected. collection is Rs 20,000.	Inlet channel maintenance, *bund* strengthening. Max.
21	TL 35,000	Village (13) contribution of Rs 2,000 per village to the common fund and	Public meetings, expenses for tank improvement activities such as meeting officials, giving petitions etc. Each village separately spends a limited donations. amount for their village level irrigation works.

Note: TL = Tank level; VL = Village level; IB = Irrigation board.
Source: Group interviews held with village elders, knowledgeable persons and *thalaiyaries*, 1995.

Table A3.15: Water Allocation in the Periyar-Vaigai System Tanks

Tank Sl No	Responsibility for sluices operation	No of months storage available in the tank to release tank water	Method adopted to overcome inadequate supply at the time of sowing	Method adopted to overcome shortage of tank supply at the end of supply season	General details
1	2	3	4	5	6
Head-reach tanks					
1	*Thotti*	Immediately after release of PMC supply	No such problem occurred so far	Farmers themselves adjust to share available water	No murai system is adopted so far. Because Periyar Main Canal (PMC) supply is certain for 2 crop periods.
2	*Madaiyan*	<---- do ---->	<---- do ---->	Head to tail for the last 1 month	--------> Nil <-------
3	*Madaiyan*	Tank gets adequate supply at the initial period	<---- do ---->	In 1994-5 *Oru Madai Paichal* (OMP) system was adopted for the last 1 month	During scarcity period some of the non-well farmers purchase well water (@ Rs 20/hour). Most wells are located at the tail-end of the ayacut.
4	*Ayacutdars* themselves	Immediately after release of TMC supply	<---- do ---->	Head to tail for the last 1 month	Thirumangalam Main Canal (TMC) supply is available for 4 months. Hence when the supply is released, farmers make use of the available supply immediately. No delay in its use. Wells are equally distributed all over the *ayacut*. Hence whenever inadequate tank supply is available it is supplemented with well water.
5	<---- do ---->	<---- do ---->	<---- do ---->	Only well water can be used during shortage period	
6	<---- do ---->	<---- do ---->	<---- do ---->	Head to tail for the last 1 month	<---------- do ---------->
Middle-reach tanks					
7	<---- do ---->	Immediately after release of PMC supply	<---- do ---->	Murai. 1990-1. Last 1 month. 3 hrs/acre.	PMC water is assured for 4-5 months. Hence no problem in getting the tank supply for this period.
8	<---- do ---->	1 month	No sowing upto the tank receiving one month supply	OMP. Last 1 month.	During OMP period 4 non-*ayacutdars* are appointed to irrigate lands. Entire ayacut is irrigated within 3 days. The remaining tank water is used after 10 days gap, i.e., 3 wettings/per month.
9	*Madaiyan*	1 month	<---- do ---->	Head to tail for the last 2 months	During the last 2 months when the supply was inadequate (10 years ago) 2 experienced *ayacutdars* irrigated the entire *ayacut*.
10	*Ayacutdars* themselves	Immediately after release of PMC supply	No such problem occurred so far	Only rainfall could help. No other method was adopted	One big farmer who lives adjacent to the tank keeps the sluice key. When water is required any farmer can approach him to release required water. 10th BC of PMC supply is also available.
11	*Thotti*	<---- do ---->	No sowing upto the tank receiving one month supply	Head to tail for the last 1 month	The inlet channel is 1.5 feet in breadth. So limited supply is available. Further a branch channel bifurcates from the inlet channel also draws more water which restricts the availability of supply
12	*Lascars* of PWD	<---- do ---->	No such problem occurred so far	Only rainfall could help. No other method was adopted	Wells are much limited. Whatever supply available from the tank is used among *ayacutdars*.
Tail-reach tanks					
13	*Ayacutdars* themselves	1 month	No crop will be raised by non-well farmers	Strict supervision	During scarcity periods, 2 experienced farmers only regulate the sluices and supervise irrigation which is carried out by the *ayacutdars*.
14	*Neerpaichi*	1 month	No crop will be raised	Only *neerpaichies* regulate supply, in all periods starting from tail to head.	Available tank supply is regulated only by the *neerpaichies*.
15	*Ayacutdars* & Sluice closers	Immediately after release of PMC supply	Well water is supplemented. No regulation of initial supply.	Only well water was used.	Any farmer can open the sluice in the morning but it is closed at 6 pm by the sluice closer everyday.

Note: In tank No 10, the ayacutdars are getting water supply illegally from 10th BC of PMC, (which passes close to the tank), instead of their actual right of the channel supply from 9th BC of PMC; OMP = Oru Madai Paichal.

Source: Group interviews held with village elders, knowledgeable persons and *thalaiyaries*, 1995.

Table A3.16: Water Allocation in the Periyar-Vaigai Non-system Tanks

Tank Sl No	Responsibility for sluices operation	No of months storage available in the tank to release tank water	Method adopted to overcome inadequate supply at the time of sowing	Method adopted to overcome shortage of tank supply at the end of supply season	General details
1	2	3	4	5	6
Head-reach tanks					
1	*Neerkatti* and Irrigation Board	1 month	No area/crop/ time restriction	Tail to head. Last 1 month.	The *neerkatti* is a govt. paid servant. His salary is Rs 1400 p/m.
2	*Madaiyan*	20 days	<----- do ----->	Head to tail. FTITL.	Channel is divided into 4 quarters. 2 is irrigated in day time time and 2 in night. *Murai* is first implemented in the deficit sluice. Only at the end murai in deep sluice was undertaken. No NI.
3	*Neerpaichi*	1-2 months	<----- do ----->	Nil	Initially well farmers raise nurseries. Ifquate supply is available non-well farmers also do the same. If storage is inadequate only wells can protect the crop. No NI.
4	*Madai Kudumban*	1-2 months	<----- do ----->	Head to tail. Last 1 month + FTITL	Since only one crop is possible whatever supply available in the tank was used for cultivation during N.E. monsoon period. No NI.
5	*Madaiyan*	1 month	<----- do ----->	<------- do ------->	<---------- do ----------> If the tank supply was poor well water was supplemented.
6	*Madaiyan*	1 month	<----- do ----->	Head to tail. Last 1 month supply is distributed by the *madaiyars*	Regular supply is available from Tirumangalam Extension Main Canal for 1 crop season. Both day and NI was undertaken.
Middle-reach tanks					
7	*Madaiyan, Thotti*	1 month	<----- do ----->	*Murai*. Once in 3 days 4 hrs supply/acre is permitted	*Ayacut* is divided into 2 portions. Each portion got 3 days supply. Only 6 days supply in a week was permitted. No NI.
8	Farmers themselves *	1 month	<----- do ----->	First come–first served basis *1	* + *1. No NI.
9	No supply was available for the past 20 years.				
10	*Madaiyan, Neerpaichi*	10 days	Crop restriction. Only paddy can be grown by using tank water	Head to tail + 2/4 sluices method. *2	*2. No NI.
11	*Neerpaichi* and Irrigation Board	2 months	Farmers are advised vised not to sow anything by expecting tank water	Well farmers should not take water during deficit supply periods	No NI.
12	Farmers themselves. *3	1 month	No area/crop/ time restriction	Following the *Vaai Madai* system. *4	*3 + *4. Both day and NI was undertaken
13	Farmers themselves. *5	1 month	<----- do ----->	Adopted the One Way Channel method. *6	*5 + *6. Both day and NI was practised
14	*Neerpaichi* and Irrigation Board	2 months	Area/crop/time restrictions are imposed. *7	Head to tail method for the last 20 days supply period	*7. Both day and NI was practised
15	Madai Variyan	3 months	No area/crop/ time restriction	Acreage restriction is implemented *8	*8. No NI.
16	Normal-farmers. Scarcity-Setham parpavar for 2 months.	2 months	<----- do ----->	Acreage restriction is implemented *8	*8. Both day and NI was done according to necessity. During deficit period Setham parpavar only operated the sluices and irrigated the alloted land.
17	*Neerpaichi*	2 months	Cultivation is done only by the head reach farmers	Adopted the One Way Channel method. *6	*6. Both day and NI was practised
18	*Kaval*	2 months	Area restriction is implemented *9	<------- do ------->	<---------- do ---------->

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Tank Sl No	Responsibility for sluices operation	No of months storage available in the tank to release tank water	Method adopted to overcome inadequate supply at the time of sowing	Method adopted to overcome shortage of tank supply at the end of supply season	General details
1	2	3	4	5	6
19	*Madaiyan*	2 months	Area restriction is implemented *9	<------- do ------->	<---------- do ---------->
20	Farmers themselves.	3 months storage of RBT	No such problem.If RBT gets 4'.5" storage one crop is possible	The tank dead storage is tapped through oil engines. *10	*10. Both day and NI was practised.
21	*Lascars* & Irri. Board	2 months	No such problem. Because supply is regulated through the Vaigai dam.	Only two days supply in a week is permitted from the tank. *11	*11. Both day and NI was practised.

Note: FTITL = Farmers themselves irrigate their lands; NI = Night irrigation; IB = Irrigation board.

* Opening of sluices is done by any one of the farmers who requires water first. If the last irrigating farmer does not require further supply he is expected to close the sluice. Otherwise, this work is done by the farmers located near sluices, mostly on the consideration of saving water.

*1 Whenever tank supply is inadequate farmers follow first come–first served basis. i.e., if a farmer requires water he can open the sluice early in the morning to irrigate his land. When he is doing so, the next farmer who also requires water must inform him to divert water to his field after his irrigation is over. Till then he must wait. This method continues one by one. Each farmer should obey this rule and act accordingly. Every deficit year this method is followed.

*2 During deficit period, the Neerpaichi daily opens the sluices in the morning to irrigat the land from head to tail. Out of 4 sluices only 2 can get supply at this deficit period. In the evening sluices must be closed. Between the 2 sluices elevated one is opened first. Only after irrigating the entire land under this sluice the other deep sluice should be opened.

*3 Whoever requires water can open the sluice. Closure of sluice is also done by the *ayacutdars*. If anyone sees that supply is going waste he can close it. Adjustments are made by the farmers according to the necessity of supply.

*4 During deficit supply period in the last 1 or 2 months *Vaai Madai* method (*Madai* system) is followed. According to this system, in each channel (total 5 chls.) there are 2 farmers appointed by the village committee to distribute water. Each channel has 20 to 30 *Vaai madais*, in which most *madais* are small size and the remaining are big. For each small *Vaai Madai* farmers have to pay Rs 2 and for the big one Rs 4 to irrigate the land under the *madais*. The amount should be paid instantly to get water as otherwise no water is to be supplied.

*5 Farmers only open/close the sluices. Whenever supply reaches a reasonable level, farmers gradually irrigate their land expecting rainfall to get more storage. If there is no rain a few can buy well water while others let the crop wither.

*6 During the last 1 month scarcity period the village organisation appoints 2 experienced *ayacutdars* to distribute water by "one way channel" method. That is at a time only one side of the channel *ayacut* is irrigated. Only if it is over the other side gets the supply. For this purpose the distributors get a cash payment of Rs 1200/ month.

*7 Area-crop-duration restrictions are imposed initially when the supply is inadequate. For instance, if a farmer owns 1 acre of land, he could be allowed to cultivate 10 to 25 cents as per the storage position of the tank initially. Only paddy should be raised. Only short duration (3.5 months) crops must be raised.

*8 Acreage restriction to the supply of tank water is implemented only at the middle/final stages of crop period. At the initial period no restriction on either crop or area because on the expectation of good rainfall to enhance tank supply farmers are cultivating in the *ayacut*. If the rainfall fails tank supply will also prove futile then only area restriction is implemented. During the shortage of supply period each farmer gets a proportionate acreage of tank supply. That is, if the tank water is enough to irrigate 1/3 of total *ayacut* each farmer gets 20 to 30 cents of supply per acre. The remaining land will wither automatically. Because there is poor supply in the wells also and only a very limited number of wells are available in the *ayacut*.

*9 Area restriction is implemented, i.e., 1 acre per family can be cultivated without considering their total holdings.

*10 This tank has a large dead storage capacity. If the tank supply is not available through sluices for cultivation, the dead storage is pumped through oil-engines to get the supply for about 10-15 days. This tank gets the direct supply from sluice no 7 of Ramnad Big Tank. Hence there is not much problem in water scarcity. Even if a month's storage is available in RBT that supply can automatically come through the sluice to this tank because of its deep location.

*11 Previously in a week 2 days' supply was restricted. But now, only two days' irrigation is allowed during scarcity period. Preference is given to crops which are at the heading stage. Water is allowed in the channels from all sluices with utmost care for irrigation to the standing crops. No wastage of supply during this period is allowed. Each *ayacut* village under this tank takes special care to regulate the supply to their *ayacut* through their local organisation.

Source: Group interviews held with village elders, knowledgeable persons and *thalaiyaries*, 1995.

Table A3.17: Performance Rating of Selected System and Non-system Tanks under Periyar-Vaigai Basin

Tank Sl No	Conditions of physical structures T *Bund* :1 T Bed :1 S & CS :2 S Weir :1 IC :1	Maintenance done in 5 years IC M/B FC ⟷ 1 to 3 times :1 4 to 5 times :2 > 5 times :3			Repairs undertaken by PWD and *ayacutdars* (5 years) 0 year = 0 1 year = 1 2 – 3 = 2 4 + = 3	No of Irrigation Functioneries		Prevalence of rationing Yes :1 No :0	Caste Multi – 1 Single – 2	No of months water supply 1-3 =1 3 – 5 = 2 5 + = 3	Min/Max .01-.40=1 .41-.80=2 .80 + = 3	% of wells/ 100 hectare 1-50 = 1 50-100=2 >100 =3	Imposition of penalty Yes = 1 No = 0	Total Col 3 to 9	Points Col 3 to 14	Location
						Higher level Nil : 0 Natt-amai-1	Lower level Nil : 0 *1 =1 *2 =2									
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
System Tanks																
5	1	2	2	2	0	0	0	0	2	4.7-2	.80-2	3	0	6	15	H
10	1	0	2	2	3	0	2	0	2	4.0-2	1.00-3	0	0	9	16	M
12	3	2	2	2	2	0	1	0	2	4.0-2	NA	1	0	9	14	M
11	1	2	2	2	0	1	1	1	2	4.0-2	NA	1	0	9	14	M
4	5	3	2	2	1	1	0	1	1	3.3-2	.86-3	1	0	10	17	H
8	1	1	2	2	2	1	1	1	2	4.5-2	1.00-3	1	0	10	18	M
6	5	2	3	2	2	1	0	1	1	3.3-2	.86-3	2	0	11	19	H
9	4	2	2	2	2	1	1	1	1	3.8-2	.87-3	3	1	11	21	M
1	4	2	3	3	2	1	1	0	2	7.7-3	.88-3	1	1	12	22	H
2	5	2	2	2	2	1	2	1	1	3.5-2	.75-2	3	1	12	21	H
14	1	3	3	2	2	1	1	1	1	4.0-2	.60-2	2	1	13	21	T
3	1	2	3	3	2	1	1	1	1	7.7-3	.88-3	1	0	13	21	H
7	3	3	2	2	2	1	2	1	1	3.5-2	.90-3	1	0	13	20	M
15	4	3	3	2	3	1	1	0	1	4.0-2	.60-2	2	1	13	21	T
13	1	3	3	2	3	1	1	1	1	3.7-2	.75-2	1	0	14	20	T
Non-system Tanks																
9	1	0	0	0	0	1	1	0	1	0.0-0	.00-0	1	0	2	4	M
3	1	1	1	1	1	0	1	0	1	2.8-1	.38-1	1	0	5	9	H
20	1	2	2	2	0	1	0	0	2	5.7-2	.83-3	0	0	7	14	T
2	0	NOIC	3	3	0	1	1	1	2	3.0-2	1.00-3	1	1	9	18	H
21	1	1	1	1	3	1	1	1	1	6.3-3	.71-2	1	1	9	17	T
4	3	NOIC	2	2	2	1	1	1	1	2.3-1	.33-1	1	1	9	14	H
12	1	1	2	2	3	1	0	1	2	4.0-2	.40-1	1	1	10	17	M
5	4	1	2	2	1	1	2	1	1	1.2-1	.33-1	2	0	10	15	H
6	3	2	2	2	1	1	1	1	2	3.7-2	.75-2	3	1	10	20	H
19	0	NOIC	2	2	3	1	2	1	2	4.7-2	.80-2	1	1	11	19	T
13	2	2	2	2	3	1	0	1	1	4.0-2	1.00-3	2	1	11	20	T
1	1	2	2	2	3	1	1	1	1	3.7-2	.75-2	1	1	12	19	H
14	1	2	2	2	2	1	2	1	1	1.7-1	.10-1	1	1	12	17	T
11	2	2	2	2	3	1	2	1	1	5.0-2	1.00-3	1	0	13	20	M
18	1	3	2	2	3	1	1	1	1	5.0-2	.50-2	1	1	13	20	T
10	2	3	2	2	3	1	1	1	2	4.7-2	.80-2	1	1	13	21	M
16	1	1	3	3	3	1	1	1	1	5.7-3	.83-3	1	1	13	22	T
15	1	3	3	2	1	1	2	1	1	6.7-3	.85-3	1	1	13	22	T
17	4	2	3	3	3	1	1	1	2	4.0-2	1.00-3	1	0	14	22	T
8	2	2	3	3	3	1	1	1	2	0.7-1	.50-3	1	0	14	21	M
7	3	3	3	3	3	1	1	1	2	4.3-2	.88-3	1	0	15	23	M

Note: *1 1 person for more than 40 hectares; *2 1 person for less than 40 hectares; NOIC = No inlet channel. Numbers (0,1,2,3) given in the column headings refer to the points of respective categories; Column 15 tells us the score on quality of maintenance; Column 16 provides the score on both management of tank water and the quality of maintenance.

Source: Survey, 1995.

Chapter **4**

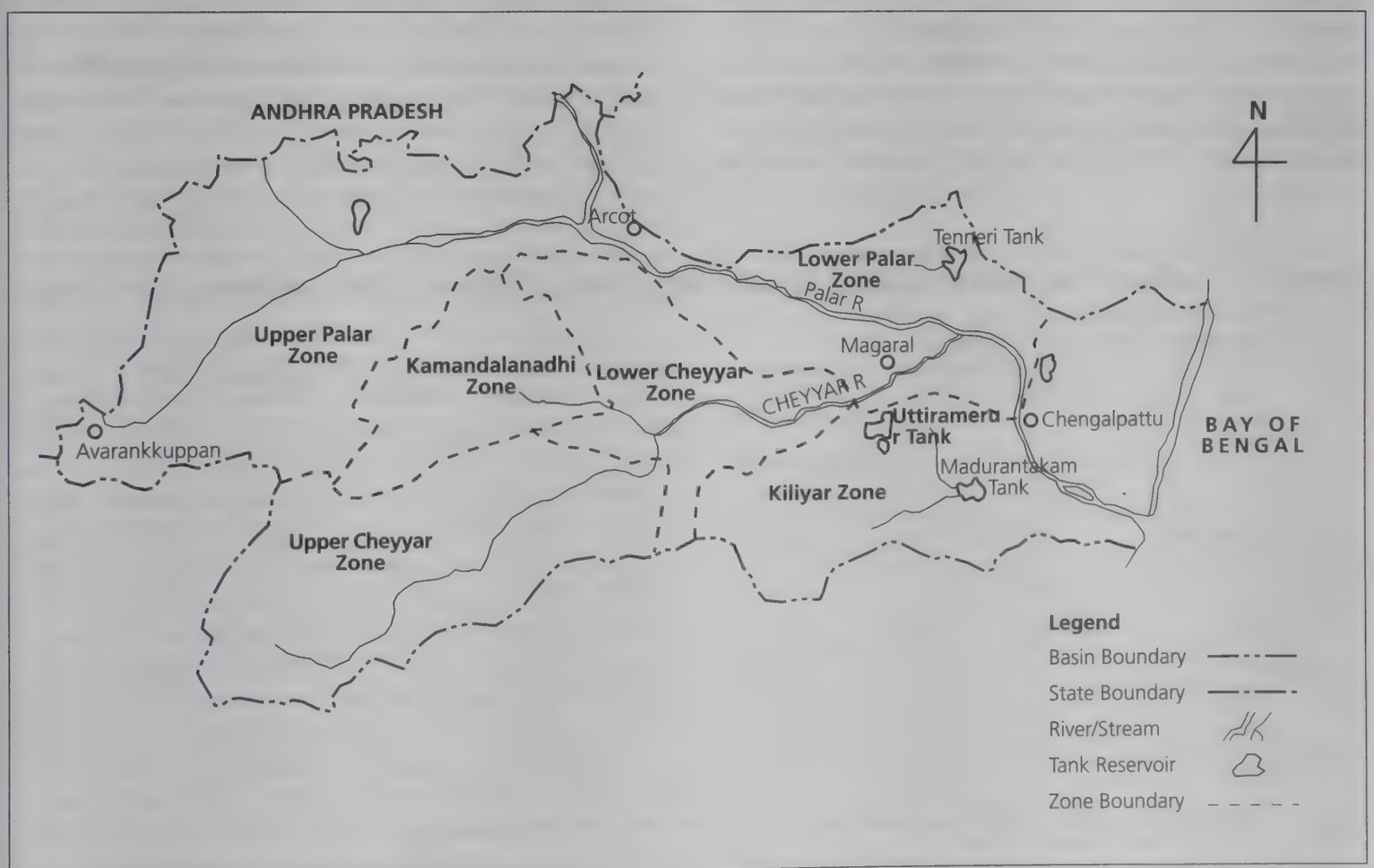
IRRIGATION INSTITUTIONS UNDER TANKS OF THE PALAR BASIN

A Rajagopal
S Mariasusai
A Vaidyanathan

The Palar basin is one of the major river basins in Tamil Nadu and covers roughly 10 per cent of the state's area. The river originates in Karnataka, passes through parts of the state and Andhra Pradesh before entering Tamil Nadu. Within Tamil Nadu, it flows through the districts of North Arcot, Tiruvannamalai and Chengalput before joining the Bay of Bengal. The basin is divided into six sub-zones whose main agro-climatic features are set out in *Table 4.1 (see also map 4.1)*. Except for parts of upper Palar, the Kamandalanadhi and Upper Cheyyar zones, which are hilly, the others are made up of more or less well-drained plain lands with moderate slope and generally with good potential for groundwater.

Rainfall averages 870 mm in the upper Palar (at the head of the basin), and increases gradually

Map 4.1: Agro-climatic Zones in the Palar Basin



eastward, consequently reaching 1,100 mm in lower Palar. The seasonal pattern of rainfall also varies, with the Southwest monsoon being relatively more important in the upper reaches and northeast monsoon in the tail-end zones. Upper Palar gets nearly 15 per cent of total precipitation in summers while lower Palar gets none.

The net cultivated area in the basin as a whole is around 370 thousand hectares; nearly 60 per cent of it is irrigated. There is hardly any canal or tubewell irrigation in the basin. Some 65 per cent of the irrigated area is served by open wells (as a sole source) with tanks (including system tanks) accounting for about a third. Wells are also used extensively to supplement surface water in tank *ayacuts*. Judging by well density, this is relatively more important in upper reaches than in lower Palar and lower Cheyyar *(Table 4.1)*.

The proportion of cultivated land, which are reported to be irrigated, is around 40 per cent in the two head-reach zones and is highest in lower Palar (75 per cent). Among others, it is about 50 per cent in upper and lower Cheyyar and 65 per cent in Killiyar. Wells are the main source of irrigation in all zones except lower Palar, which is predominantly tank-fed. The importance of tanks increases as we move from the head reach zones to the tail-end zones. Irrigated crop patterns also vary. While zone-wise details are not readily available, a comparison of district-level data suggest that in North Arcot (which is in the upper part of the basin), while paddy is important, as much as 40-50 per cent of gross irrigated area is under commercial crops (like groundnut and sugarcane). In Chengalput — located in the lower part of the basin — irrigation is predominantly used for growing paddy.

CRITERIA FOR SELECTION OF TANKS FOR THE STUDY

We selected upper Cheyyar, lower Palar and Kiliyar tanks for detailed study. The bulk of tank-irrigated area is concentrated in these zones. Being located in the head, middle and tail-reaches of the basin, they capture differences in location and agro-climatic conditions. These three zones have 538 rainfed and 235 system tanks, their size ranging from 40 ha of *ayacut* to over 400 ha. The large majority in both categories serves *ayacuts* ranging between 40 and 200 ha *(Table 4.2)*. They also differ in terms of the quantum of storage per hectare of ayacut *(Table 4.3)*. Among rainfed tanks, those with *ayacuts* less than 100 ha constitute a larger proportion of all tanks in upper Cheyyar; rainfed tanks serving larger *ayacuts* are more prominent in lower Palar and Kiliyar. But upper Cheyyar tanks have a larger storage capacity per unit of *ayacut*. Among system tanks the picture is different: Tanks with smaller *ayacuts* are relatively more numerous in the lower reach zones; while capacity per unit of *ayacut* is the highest in Kiliyar zone.

From each zone a number of rainfed and system tanks were chosen for detailed investigation. Limitations of time and resources precluded the use of rigorous procedures to get a representative sample. The selection was purposive keeping in mind the need to capture different types (by location, size of *ayacut* and storage per *ayacut*) and logistic convenience. Altogether 40 tanks were chosen; 22 non-system tanks (seven from upper Cheyyar eight from lower Palar and seven from Killiyar); and 18 system tanks (four from upper Cheyyar, sevem reach from the other two zones). The frequency

Table 4.1: Salient Features of Agriculture and Irrigation in Different Parts of Palar River Basin, Tamil Nadu

Zone	Area sq km	Total rainfall (mm)	Southwest monsoon contribution (%)	Net sown area	Net total	Irrigated tanks	Area open Wells	GCA	GIA
				'000 ha				NSA	NIA
Upper Palar	3,085	871	48.3	38.7	17.4	1.5	14.0	1.13	1.14
Kamandala Naganadhi	824	1,056	43.4	44.6	17.5	2.1	14.5	1.22	1.46
Upper Cheyar	1,964	1,041	44.7	96.8	50.2	8.5	40.4	1.21	1.35
Lower Cheyyar	1,151	1,048	47.6	51.0	26.2	7.6	18.4	1.15	1.27
Lower Palar	1,569	1,155	39.0	55.6	41.3	27.9	11.2	1.18	1.24
Kiliyar	2,287	1,091	44.1	82.2	54.5	18.9	35.4	1.15	1.12
Palar Basin	10,880		368.9		207.1	66.5	133.9		

Note: GCA = Gross cropped area; GIA = Gross irrigated area; NSA = Net sown area; NIA = Net irrigated area.
Source: Tank level G-returns, grouped into zones.

Table 4.2: Frequency Distribution of Tanks in Selected Zones of Palar Basin by Size of *Ayacut* in Hectares

Zone	< 40	40-100	100-200	200-400	> 400	Total
rainfed Tanks						
Upper Cheyar	3	82	13	6	–	104
Upper Palar	13	83	49	14	7	166
Kiliyar	18	145	70	24	11	268
All	34	310	132	44	18	538
System Tanks						
Upper Cheyar	–	8	1	8	–	47
Upper Palar	10	23	18	15	4	70
Kiliyar	12	84	16	4	–	116
All	22	115	65	27	4	233

Note: – Indicates nil.
Source: Survey, 1995.

distribution of selected tanks by size of *ayacut* and storage capacity per ha of *ayacut* is summarized in *Table 4.4.*

TECHNICAL CHARACTERISTICS OF THE PALAR TANKS

The technical characteristics of the selected tanks compiled from official, village and PWD records are detailed in the annexure to this chapter. *Table A4.1* gives the relevant information for system tanks and *Table A4.2* for rainfed tanks whose working was explored in this study.

SUPPLY SOURCES

Most of the selected system tanks in the head and the middle reach of the basin receive water supply directly from the canal through independent supply sluices. In the tail-reach, tank-to-tank supply is the norm. All tanks also get supplies from rainfall run-off in their free catchment. The extent of free catchment per hectare (ha) of *ayacut* is much higher for tanks situated in the tail-reach; and the least in the middle. Non-system tanks — which depend entirely on catchment run off — are of two types: those which form part of a chain get supplies from their own catchment and surplus flows from upstream tanks. These constitute the majority (13 out of 22) of selected tanks. The rest are isolated tanks depending entirely on run off from their free catchment. The isolated tanks have much larger free catchment relative to *ayacut.* Among chain tanks, those in the head have larger free catchment per unit of *ayacut* than the middle or tail.

The majority of system tanks (10 out of 18) are rated as class IV tanks capable of supplying water for less than three months; seven are class II tanks (3-6 months supply). Only one belongs to class III. All the selected head reach tanks belong to class IV, while six out of seven in the tail-reach are in class III *(see Table A4.1).* Non-system tanks are designed to get longer duration of supplies; half of them are class III tanks and about a third are in class II. The proportion of non-system tanks in class II is highest in the head reach and the least in the tail-end of the basin *(Table A4.2).*

As is to be expected, the extent of double cropland in the *ayacut* is directly related to the duration of supply — more land is double-cropped when water is available for a longer duration. The quantum of storage per unit of *ayacut* has a significant bearing on the duration of supplies. Thus only half the class III system tanks have storage of more than 5,000 cubic metres (cum)/hectares (ha), while all class II tanks fall in this category. Among non-system tanks too none of the class IV tanks have storage exceeding 10,000 cum/ha while five out of seven class II tanks do.

However, in several tanks the extent of *ayacut* as per PWD rating is at considerable variance from that reported by revenue department's village records. In the case of system tanks, revenue record figures exceed those of PWD in five cases: marginally in three instances and by 35 and 60 per cent in the remaining two. In 11 tanks, *ayacut* as per revenue records is less than the PWD figure, the difference being less than 10 per cent in five cases and more than 25 per cent in three tanks. It is noteworthy that the *ayacut* recorded in the *Adangal* — which is probably close to actual — is less than the PWD figures in a majority of selected tanks in the tail-reach than in the upper reach.

Table 4.3: Distribution of Tanks in Selected Zones by Capacity per Hectare of *Ayacut* in '000 Cubic Metres

Zone	< 5	5-7.5	7.5-15	>15	All
rainfed Tanks					
Upper Cheyar	12	16	64	12	104
Lower Palar	66	22	62	16	166
Kiliyar	97	51	82	38	268
All	175	89	208	66	538
System Tanks					
Upper Cheyar	8	6	28	5	47
Lower Palar	26	18	23	3	70
Kiliyar	2	5	78	31	116
All	36	29	129	39	233

Source: Survey, 1995.

Table 4.4: Frequency Distribution of Tanks Selected for Study by Size and Storage Capacity

Zone	Tank category	*ayacut* size (ha)			Storage capacity ('000 cubic metres/hectare)			
		40-100	100-200	200-400	< 5	5-7.5	7.5-15	> 15
Upper	rainfed	2	3	2	–	2	2	3
Cheyyar	System	3	1	–	1	1	2	–
Lower	rainfed	2	4	2	2	2	2	2
Palar	System	2	3	2	3	–	3	1
Kiliyar	rainfed	2	4	1	3	–	2	2
	System	1	4	2	–	1	3	3

Note: Indicates nil.
Source: Survey, 1995.

Discrepancies between revenue and PWD figures of registered *ayacut* are also noticed in a majority of non-system tanks but the extent of difference is much smaller, exceeding 10 per cent only in 5 cases out of 21. Interestingly, in contrast to system tanks, instances where revenue records show a larger registered *ayacut* than the PWD are concentrated in the tail-reach of the basin. Those in which revenue records show a smaller *ayacut* than the PWD are concentrated in the middle reach. Officials could not explain these differences. As we shall see later, it is difficult to explain them in terms of actual water availability relative to the original rating of the tanks.

A great majority of tanks surveyed have multiple sluices but serve single village. Only three of the system and four of non-system tanks are multi-village tanks. The storage capacity per hectare of *ayacut* varies from less than 1,300 cum to 16,000 cum. The majority of the selected head reach tanks have between 5,000-10,000 cum per ha. The majority in the middle reach has less than 5,000 cum/ha. Most tail-end tanks have more than 5,000 cum/ha with three out of seven having more than 10,000 cum/ha. Free catchment per hectare of *ayacut* in the head and middle reach is considerably lower than in the tail. Seven out of 10 tanks in the former have less than two ha free catchment per ha of *ayacut*, compared to one out of seven in the tail-reach. Three of the tail-end tanks have more than five ha.

CONDITIONS OF PHYSICAL STRUCTURES IN THE SELECTED TANKS

This section deals with the current conditions of inlet channel, surplus weir, tank *bund* and other physical structures of the tanks. It is widely believed that inadequate attention to repair and upkeep has led to a considerable deterioration in these facilities. Our survey confirms this impression and gives some idea of the magnitude of the problem in the selected tanks.

INLET CHANNEL

Inlet channels of all the selected system tanks were found silted, encroached and affected by heavy weed growth. Practically all of them report significant reduction in the depth and width of the channels due to interference of the upstream farmers for direct irrigation and construction of houses. The feeder channels of five tanks are reported to be fully silted and encroached.

Table 4.5 provides details about the extent of siltation and encroachment in the inlet channels of the selected system tanks. Reduction in depth and width of the channels is indicator for siltation and encroachment problems. Siltation (which reduces the depth of channel) seems to be the more important problem than encroachment (which reduces width). In 13 out of 18 tanks, the inlet channels have silted up to more than half of their actual depth. Encroachments in eight tanks exceed 50 per cent of their width. Siltation is found in all the reaches, so is encroachment. But the problem seems to be especially serious in middle reach tanks. Four out of the seven tanks in this segment have suffered severe encroachment of more than 75 per cent and siltation of similar degree. Significantly, however, farmers continue to depend on the tanks for irrigation. None of the tanks has gone out of use.

Heavy weed growth, siltation and encroachment also affect the inlet channels of most non-system tanks (19 of 22). Encroachment is not a problem in five tanks; three report the channels to be fully encroached. Five do not seem to have any siltation. Only one tank reports to

be free of both. The majority faces both problems. The extent of reduction in width and depth could not be ascertained in all cases. But judging from the information available, their severity seems considerably less than in system tanks.

THE TANK *BUND*

The *bunds* of a large majority of system tanks (14 out of 18) are reported to be breached in many places; weak *bunds* are found in four tanks *(Table A4.3)*. The problem arose in two instances due to the breaching of the *bund* by upstream villages to drain excess water in their habitations. In some tanks, eg, Nandhimangalam and Kottakulam eri, the whole of *bunds* have been reported to be very weak. In one tank (Muttavakkam eri), the *bund* was weakened due to the interference of upstream villagers to drain water during 1955. Conflict arose and a court case was also filed. Though the judgement was clearly against such activity by the upstream villagers, the problem continues. Likewise the *bund* of the Melpadi eri has been weakened due to the interference of the *oorkudi* farmers to drain water during 1986-91. Also the tank *bund* was used as a cart track which led to weakening of the *bund*. This problem has affected the supply to tank considerably.

Weak *bunds* are noticed in all the 22 non-system tanks *(see Table A4.4)*. Man-made breaching is said to be responsible for this state. The number of breaches varies from two in some tanks to as many as 10 in a few. In some tanks viz., Sengattur and Munnuthikuppam, the whole *bund* is said to be weakened. In Kappalur the local village people have breached *eri* (HR) about 1.5 kms length of the *bund* because of the cutting of firewood. *Arrack* sellers used to dig pits at several places in Adanur eri to store the *arrack* safely leading to the weakening of the *bund* in recent times. Breaches of *bund* (about 100 - 200 meters) in two places between Pallamadagu and surplus weir has been identified in Kunnathur hissa eri also. Lack of surplus weir in Munnuthikuppam eri causes the *bund* to be breached very often to an extent of 300 feet. This occurred during the years 1966 and 1967, and again between 1988 and 1995. Whenever the *bund* was broken people joined together to plug the breaches. They also often petitioned the PWD to construct a separate surplus weir but no action has been taken. Thus it is clear that breaching of *bund* is found to be common in all the reaches as this affects most tanks.

THE TANKBED

Almost all the tanks are affected by siltation and encroachment. However, in the absence of systematic surveys it is impossible to assess the extent of siltation and its effect on storage capacity. Villagers however report this is to be a widespread and serious problem. They also seem to have some idea of its extent. Though notional, it is useful to note their perception. According to knowledgeable residents of survey villages, ten system tanks are silted up by more than half their capacity; in another five the siltation is between 25 to 50 per cent; in two tanks the problem is not so serious. While the problem is found in some degree in all tanks, the incidence does not seem to vary significantly across reaches. In many villages, informants reported that about 20-30 years' back, when the tank was full they were able to raise 1-2 crops of paddy in most of the *ayacut*. However, due to heavy siltation, it has become difficult to raise even a single paddy crop in many of the tanks.

Encroachment on tankbed has become an important problem, especially in recent times. Cultivation in the tankbed seems to be resorted to by both small and big farmers. Encroachment on tankbeds by farmers of the same or upstream villages is noticed in 14 out of 18 system tanks. Only four are free of this problem. The extent of encroachment in many cases are in the range of 10-20 acres and in a few cases, 30-60 acres. In the head reach Sorpanandal *eri* about 60 acres have been encroached by the upstream Kalathambadi villagers since 1975 for raising paddy crop. One well is also dug in this place to irrigate the crops. The villagers used to petition the higher officials for necessary action,

Table 4.5: Details of Reduction in Depth and Width of the Supply Channels in System Tanks

Sl No	Extent of reduction (%)	Reach	Reduction in depth (No of tanks)	Reduction in width (No of tanks)
1	< 50	H	1	2
2	50 - 75	H	2	1
3	75 -100	H	1	1
	Total		4	4
1	< 50	M	2	3
2	50 - 75	M	1	nil
3	75 -100	M	4	4
	Total		7	7
1	< 50	T	2	5
2	50 - 75	T	4	2
3	75 -100	T	1	nil
	Total		7	7

Source: Field Survey, 1995.

but no action was taken so far. In the case of Keelsathamangalam *eri* also the upstream farmers of Avanavadi, and Mampattu, have reported the problem of encroachment in an area of about 30 acres since 1985 for raising paddy and groundnut. Three wells fitted with oil-engines have also been used to irrigate crops. In the case of Thirumangalam and Butheri tanks, about five to 10 acres have been encroached since 1980 for house construction. A few other villagers also reported the same problem, e.g., Sogathtur eri (15-20 acres), Melpadi eri (30 acres) and Elangadu (10 acres). Due to encroachment on tankbed in Mahadevimangalam *eri* breaching of the *bund* has been reported. The encroachers generally cut open the *bund* in order to save the crop from flooding during heavy rains. Every year it is breached for this reason. The effect of encroachment has been more in the middle and tail-reaches mainly because the tanks did not get adequate water supply.

In a majority of non-system tanks (12 out of 22), *ayacutdars* estimate that siltation reduced their capacities by more than half; in eight others the siltation is placed between 20-25 per cent. The head and middle reach tanks are affected more by this problem. In the head reach, siltation in four out of seven tanks is estimated to be more than 50 percent; in the remaining tanks it is 20-30 per cent. In five of the seven middle reach tanks, about 63 per cent is silted. In the tail-end, only three tanks had heavy siltation and three other tanks had moderate (20 to 30 percent) siltation.

Encroachment of tankbed, which has also become a serious problem in non-system tanks; 16 out of 22 tanks are reportedly affected by this problem. It is found to be almost equally important across all the reaches. The extent of encroachment varies from 3-4 acres to as much as 70 acres. The land affected by encroachment is relatively more in the head and middle reach tanks than in the tail-reach. This has also contributed to reduction in the storage capacity. Since crops grown on encroached land may be lost or damaged and even cultivation may become impossible due to submergence, encroachers have an incentive to see that the tank does not get filled. Instances of their breaching *bunds* and surplus weirs to avoid such losses have been reported.

SLUICES AND CONTROL STRUCTURES

In general, most of the tanks have 3-4 sluices. There are very few tanks with a single sluice. One of the tanks, viz. Ulundai peria eri, has an unusual device; a vent below the surplus weir known as *Salaram* for irrigation.

Most of the sluices are in a dilapidated condition. Fourteen system tanks reported this problem: Out of a total of 51 sluices, the condition of 23 sluices (45 per cent) is very bad; sluices of eight tanks are wholly damaged. Some have been abandoned after efforts to get them repaired by the PWD or by the *ayacutdars* themselves. In Nandhimangalam eri (HR) one of the sluices, *mettu madagu* has been abandoned since 1994 due to heavy water leakage. The users themselves attempted several times to close the leakage, but failed because they did not have the needed technical expertise and could not afford the high cost. In three tanks the sluice design is defective and affects the flow of water even during normal years. This problem is reported in all the four sluices of Muttavakkam eri and two sluices of Singlipadi eri, and one in Thirumangalam eri.

The lack of shutters to regulate the flow through the sluices is the other defect noted in almost all tanks. Except for two tanks, Kottakulam and Butheri, where the *ayacutdars* have put wooden shutters in place, others lack shutters. Attempts at repairs have not been successful. In many places, farmers close the sluices by using mud and stone to prevent waste, but this makes effective regulation of water difficult. It also takes a considerable amount of physical labour and collective efforts, which have been difficult to mobilise because of weak tank level organisation. In many tanks, water is let out without any control due to lack of regulatory structures. In the case of *Muttavakkam*, farmers themselves made efforts to repair the *palla madagu* by spending about Rs 2,500 during 1994-95. Still the problem continues.

A great majority of non-system tanks also have multiple sluices (the number varying between two and six). Only one has six sluices. The sluices in most tanks (21 out of 22) are in a dilapidated condition; in 12 of them the sluices are fully damaged. Out of 70 sluices under 22 tanks, conditions of 48 sluices are reported to be defective due to inadequate maintenance and repair. This problem seems to be more in middle and tail-reach tanks than the head reach. This may be due to meager water supply under some tanks. Along with defective sluices, lack of devices to control water adds to the problem. Almost all the tanks (except one) have no shutter arrangements, thereby leading to wastage of water. Farmers in a few tanks reported attempting to tackle this problem but their efforts proved ineffective because the dilapidation was far too serious for them to repair.

CONDITIONS OF SURPLUS WEIRS

About half of the system tanks have only one surplus weir; and a third have two surplus weirs. A very few have three surplus weirs. The number of weirs seems to be related to the reservoir capacity. Tanks with larger holding capacity (6-8 months) require more weirs to drain surplus inflow and safeguard the *bunds* during

flood periods. Surplus weirs are generally reported to be in good condition. But in eight tanks their condition is said to be extremely bad. In three of them (Mahadevimangalam, Thenampakkam and Ponneri) weirs are broken in many places, resulting in water leakage and reduction of storage capacity. Encroachment of tankbed also contributes to damage to weirs. In one case (Thimmasamudram eri) farmers who also owned wells in the tankbed demolished the entire weir nearly 25 years ago. Encroachment on its supply channel has reduced the inflow. The tank has not been filled since 1980, thus facilitating encroachment of the tankbed for cultivation.

The majority of non-system tanks (15 out of 22) have one surplus weir — four have two and two have three surplus weirs. One tank has none. The surplus weirs are generally in good condition. They were found damaged or breached in four tanks mainly due to poor maintenance. On the whole, the condition of non-system tanks in this respect seems better than system tanks.

WATER SUPPLY CONDITIONS IN THE SELECTED SYSTEM TANKS

Sources of Water Supply

Mainly the Palar and its tributaries feed the selected system tanks. They also benefit from drainage in free catchment area and in some cases surplus from the upstream tanks. Channels mainly feed the head reach tanks from the tributaries of Palar viz. Beemanadhi and Cheyyar. The middle-reach tanks get supply from the Kambakkal channel of Palar anicut and Vegavathi river, a tributary of Palar. Tail-end tanks depend on the surplus flows from upstream tanks and drainage from catchment.

Practically all tanks complain that supplies received are much below the designed level. The main reason for this is that the capacity of inlet channels to carry water has been reduced by widespread siltation and encroachment and heavy weed growth in some cases. The extent and severity of the problem has been already discussed.

A second contributory factor is the attempt on the part of upstream tank *ayacutdars* and farmers along inlet channels to appropriate more water than they are entitled to. This takes several forms: obstruction of water supply by constructing (mud and concrete) *kondam* across the river; unauthorised tapping of water from inlet channels by cross-*bunding* and/or lifting of water directly from them; tapping of water for direct irrigation by unauthorised *ayacutdars;* and illegal raising of the height of surplus weir. In some cases cutting the *bunds* of the inlet channels to avoid flooding of upstream villages reduces the flow in the channel. The most frequently cited reason is unauthorised diversion from inlet channels (nine cases) followed by encroachment.

The following cases are illustrative for the nature of these problems: Nandhimangalam eri suffered because upstream tank *ayacutdars* constructed a mud structure across the river to secure more water. The problem worsened when this mud structure was replaced by new concrete construction. The topography of the place itself favours the upstream tank *ayacutdars* whose lands are in a low-lying area compared to Nandhimangalam. Because of this, Nandhimanglam tank has not received even one filling in 1993 and 1994.

The supply channel of Kottakulam eri is silted up due to the formation of a mud road nearby. The commissioning of a large number of borewells along the riverbed (since 1985) reduced the water flow in the river. The inlet channel is also at a higher elevation relative to the river necessitating construction of a *kondam* to divert water into the channel. Since the *kondam* (made of mud) gets washed away often, work on repairing the *kondam* has to be done several times during the season involving huge amount of labour on the part of the *ayacutdars.* About 150 farmers are generally involved in such construction.

Supplies to Sorpanandal eri are reported to be adversely affected by illegal construction of about 80 *kondams* across the channel and encroachment on it; the use of *kavalai* by farmers along the upper reaches of the channel to lift water directly from the channel; and malfunctioning of the diversion box meant for allocating the water supply at the head of the supply channel.

In the case of middle reach tanks also, illegal tapping of water from the supply channel and its encroachment are the major problems. For example, in Thimmasamudram periya eri, encroachment of the supply channel by upstream *ayacutdars* has affected the water supply for a long time and depends wholly on rainwater. The Kambakkal channel which supplies water to Thirumangalam eri takes off about 45 kms from the tank. A major problem is that the channel flow is illegally tapped by erecting mud *kondam* in it by upstream villagers both for direct irrigation and to supply their percolation ponds. The problem is aggravated because the tank is at the tail-end and has not got even one filling since 1986.

In the tail-end of the system, two tanks report reduction of supplies due to illegal tapping from inlet channel and encroachment. There is also a case where raising of the surplus weir by an upstream tank (Soraputhur) to store more water which has led to shortage of water to the lower tank, Elangadu periya eri *(see Table A4.5).*

Supplies during 1992-94

Water is generally released in the head-reach tanks during the months of *Puratasi* or *Ippasi*. However, there are significant differences in this respect across reaches: In 1994-5, two of them released in *Puratasi* and two in *Ippasi*. In earlier years, one tank began release even in *Aavani*. Releases in mid-reach tanks start about a month later, being concentrated in *Karthigai* and to a larger extent *Margazhi*. In the tail-end the release dates are spread over a wider period, from *Aavani* to *Karthigai*. It is to be noted that some tanks in the middle and tail-reaches did not release any water in two of the three years, the incidence of this being more marked in the tail-end *(Table 4.6)*.

The extent to which the selected tanks have been adversely affected is highlighted by the information given by farmers on the duration of water supply received in three years (1992 to 1994) preceding the survey *(see Table 4.7)*. It was reported that about one-third of the system tanks did not get filled in any of the three years. Of the remaining tanks, four surplused only once; four tanks received water supply to the full capacity in two years, and only four tanks got surplus filling in all the three years. In other words, the majority of tanks (10 of the 18) did not get filled up in two out of the three year period. Only four surpluses were reported during all the three years. The problem is more acute in the middle reach where six out of seven selected tanks did not fill in any of the years. The tail-reach seems somewhat better placed — with four out of seven tanks filled for at least two years. The least affected are the head-reach tanks.

Table 4.8 provides details about deficit in duration of water supply provided by the tanks (average for the period 1992-94) compared to duration for which they are expected (according to the PWD classification) to provide irrigation. It is seen that except for two tanks others could not supply water as expected of their class rating, and the difference ranges from 10 per cent to as much as 77 per cent. The reduction is 50 per cent or more in 11 tanks: six of them in the middle and four in the tail-reach. In fact, the middle reach tanks seem to be worst affected followed by the tail-end. Head-reach tanks, of which two continue to get rated supply and one is only 10 per cent short, are evidently least affected.

Within the *ayacut* of selected tanks, conditions of water supply are reported to differ between head and tail-reaches in 11 out of 18 tanks. The problem is found mostly in tanks, which received only one filling, and in class III-IV tanks. Generally, tail-reaches faced scarcity for about 15-30 days under these tanks. In the case of larger tanks (*Melpadi, Nallur and Elangadu*) the problem is seen only during the second season. In a few tanks, where some kind of arrangements for rationed distribution of water is in vogue, the head and tail problem has not arisen.

Conjunctive Use of Groundwater

It is conceivable that the shortages in tank water may have been made up by the spread of conjunctive use of groundwater. Most of the system tanks report wells in their *ayacut* the density varying from as low as five wells per 100 ha to over 200. The densities are relatively high in the head and the tail-reach tanks; but it is very low in the middle reach and several of the tanks in this segment have no well at all *(see Table 4.9)*.

Assuming that well density is a reasonable index of access to well water, it would seem that the overall irrigation supplies to *ayacuts* of head reaches have suffered the least. In the tail-end, where high well densities are accompanied by large deficits in tank supply, the deterioration is likely to be greater. But the middle reach — which combines large reductions in tank supply

Table 4.6: Distribution of Tanks by Date of Water Release (1992-94)

Sl No	Month	1994 – 95				1993 – 94				1992 – 93			
		H	M	T	Total	H	M	T	Total	H	M	T	Total
1	*Avani*	–	–	2	2	1	–	1	2	1	–	–	1
2	*Puratasi*	2	–	2	4	2	–	3	5	1	1	1	3
3	*Ippasi*	2	1	1	4	1	1	2	4	2	–	1	3
4	*Karthigai*	–	2	1	3	–	2	1	3	–	–	1	1
5	*Markali*	–	3	–	3	–	4	–	4	–	4	–	4
6	*Thai*	–	–	–	–	–	–	–	–	–	–	–	–
7	Water not released	–	1	1	2	–	–	–	–	–	2	4	6
Total		**4**	**7**	**7**	**18**	**4**	**7**	**7**	**18**	**4**	**7**	**7**	**18**

Note: H = Head; M = Middle; T = Tail; – Indicates nil.
Source: Field Survey, 1995.

Table 4.7: Distribution of Tanks According to Number of Surplus Filling Years During 1992-94

Sl No	category of surplus filling	Number of tanks			
		Head	Middle	Tail	Total
1	Never filled up for all 3 years	–	6	–	6
2	Not filled up for 2 years	1	–	3	4
3	Not filled up for 1 year only	1	–	3	4
4	Filled up during all the 3 years	2	1	1	4
	Total	**4**	**7**	**7**	**18**

Note: – Indicates nil.
Source: Field Survey 1995.

with low well densities — clearly must have suffered the most. However, the extent of deficit in tank supply (relative to original rating) and well density *(Table 4.10)* do not seem to be strongly correlated. Half the tanks which report less than 25 per cent deficit have high well density; but all tanks with deficit of 25 to 50%, and over half of these with deficit exceeding 50% have low well density. One should be cautious in drawing inferences from these data; the number of wells is not a reliable indicator of the volume of supply in as much as yield per well varies a great deal.

The *ayacutdars'* assessment of water supply, not being based on any systematic measurements, is necessarily notional. In principle the area actually irrigated could be used as cross-check. But this is not possible because the village records of area irrigated by source are unreliable: A perusal of village Adangal showed that the area under tank irrigation recorded in the registers shows little variation from year to year. In most cases the reported figures are the same as the registered *ayacut*, even though the duration of supplies was reported in most cases to be substantially below the

Table 4.8: Duration of Water Supply in Tanks Across Reaches

Sl No	Reach/tank	Entitlements (months)	Actual Duration of supply (month)			Avg for 3 Years (months)	Extent of deficit (%) (6/2)	No of wells per 100 hectares of *ayacut*
			1994	1993	1992			
1	2	3	4	5	6	7	8	9
Head-reach								
1	Nandhimangalam	3	40*	20*	2	1.3	56	135
2	Kottakulam	3	3	4	4	3.7	0	29
3	Sorpanandal	3	3	5	5	4.3	0	43
4	Valayampattu	3	3	3	2	2.7	10	63
Middle-reach								
5	Singlipadi	3	15*	3	7*	1.2	58	0
6	Mahadevimangalam	4	3	3	3	3	25	0
7	Butheri	6	4	4	1	3	50	10
8	Muttavakkam	4	2	2	1	1.6	59	34
9	Thimmasamudram	4	1	1	20*	0.9	78	13
10	Thirumangalam	4	2.5	2.5	1	2	50	0
11	Thenampakkam	4	2	2	2	2	50	5
Tail-reach								
12	Ulundai	6	4	4	10*	2.8	53	41
13	Sogathur	4	3	3	3	3	25	159
14	Nallur	6	6	6	2	4.7	22	85
15	Melpadi	8	6	1	10*	2.4	70	210
16	Keelsathamangalam	8	7	4	10*	3.8	53	20
17	Elangadu	8	6	6	1	4.3	46	65
18	Ponnur	6	1.5	5	2	2.8	53	58

Note: * Figures relate to number of days supply.
Source: Field Survey, 1995

Table 4.9: Well Density in the Selected System Tanks

	Number of wells/100 ha of *ayacut*					
Reach	**0**	**1-25**	**25-50**	**50-100**	**> 100**	**Total**
Head	–	–	2	1	1	4
Middle	3	3	1	–	–	7
Tail	–	1	1	3	2	7
Total	**3**	**4**	**4**	**4**	**3**	**18**

Note: – Indicates nil.
Source: Survey, 1995.

duration expected given the rating of each tank. The quality of data on water utilisation and area irrigated leave much to be desired.

WATER SUPPLY CONDITIONS IN NON-SYSTEM TANKS

Sources of Water Supply

The main sources of supply for the non-system tanks, which form part of a chain, are surplus water from upstream tanks, drainage from free catchment and fields. Isolated tanks (seven) get water supply only from their catchment area. The length of the supply channels of the selected tanks varies from 2 to 12 kms. As already noted, encroachment and siltation have reduced the capacity of supply channels in most cases. Moreover, as in the case of system tanks, illegal diversion of water from supply channel for direct irrigation, obstruction of supply channel by using cement pipes and cross-*bunding* and encroachment of supply channel and *kasam* are also frequent. All this would imply that actual supply is less than rated supply even during normal years. Surprisingly, however, the incidence of these problems seems to be considerably less in non-system tanks. Only 10 of them, mostly chain tanks, report illegal upstream diversion of channel flow or channel encroachment; eleven do not have this problem *(see Table A4.6)*.

Table 4.10: Relation Between Well Density and Extent of Deficit in Tank Supply in the Selected System Tanks

Deficit	**Well density**					
%	**0**	**1-25**	**25-50**	**50-100**	**> 100**	**Total**
0	–	–	2	–	–	2
1 - 25	1	–	–	2	1	4
25 - 50	1	2	1	–	–	4
> 50	1	2	2	1	2	8
Total	**3**	**4**	**5**	**3**	**3**	**18**

Note: – Indicates nil.
Source: Survey 1995.

Supply Conditions During 1992-94

The timing of first water release in non-system tanks *(Table 4.11)* differs from the observed pattern in system tanks. Releases are spread over a longer period. It begins in some cases as early as *Aavani*, while in some it can be as late as *Thai*. Over the three-year period covered by the survey, releases started as early as *Aadi* in one instance; and took place as late as *Thai* in four instances. *Puratasi* is the most frequent month for release, followed by *Markali* and *Aavani*. But this pattern varies across reaches and years. Head reach releases are spread between *Aavani* and *Karthigai* with a bunching in *Puratasi*. Releases also start in *Aavani* in some mid-reach tanks; some however release it as late as *Thai* but here *Karthigai* is the most frequent month of release. On the whole water release in this reach is a couple of months later than in the other reaches. In the tail-end water was released as early as *Aadi* in one case and as late as *Thai* in two instances. The large majority, however, release water in *Puratasi* and *Ippasi*.

During the three-year period covered by the survey, about seven tanks did not get even one filling in any year. Only nine tanks report being filled up during all the three years. It is noteworthy that none of the head reach tanks got filled up during all the three years; five of them did not get filled in any year. Four of the middle reach tanks were filled in all three years, two in two years; and two were never filled. The tail-reach tanks seem to be best placed with five out of seven reporting filling in all three years *(Table 4.12)*. In this respect, the pattern of variation among non-system tanks across reaches presents a sharp contrast with the system tanks.

The actual duration of water supply (average for the period 92-94) as reported by knowledgeable villagers compared to number of months expected for its class is presented in *Table 4.13*. Only two tanks reported the actual duration of supply to be equal to its original rating. In all the rest, the actual duration was less than rating: The deficit being more than half in one third of the tanks and between 25 and 50 per cent in another 40 per cent. The incidence of deficit is highest in the head reach and the least in the tail segment.

In head-reach tanks farmers reported that in the past, when the tank was full they were able to raise one crop successfully in the whole *ayacut*. But in recent times they could not raise even one full crop due to deficient filling and shortage of water supply. The

Table 4.11: Distribution of Tanks by Date of Water Release (1992-94)

Sl No	Month	1994 – 95				1993 – 94				1992 – 93			
		H	M	T	Total	H	M	T	Total	H	M	T	Total
1	*Aadi*	–	–	1	1	–	–	–	–	–	–	–	–
2	*Aavani*	1	1	1	3	2	2	1	5	1	1	–	2
3	*Puratasi*	3	2	2	7	2	1	3	6	3	2	3	8
4	*Ippasi*	1	–	2	3	1	–	2	3	–	–	1	1
5	*Karthigai*	2	2	1	5	2	4	–	6	1	1	1	3
6	*Markali*	–	2	–	2	–	–	–	–	–	2	–	2
7	*Thai*	–	1	–	1	–	1	1	2	–	–	1	1
8	*Masi*	–	–	–	–	–	–	–	–	–	1	–	1
9	Water not released	–	–	–	–	–	–	–	–	2	1	1	3
	Total	**7**	**8**	**7**	**22**	**7**	**8**	**7**	**22**	**7**	**8**	**7**	**22**

Note: Indicates nil; H = Head-reach; M = Middle-reach; T = Tail-reach.
Source: Field survey, 1995.

available water was used only by the palla madagu *ayacutdars* under the deep sluices who have access to well irrigation. Getting filled up does not however, necessarily mean that supply is adequate. This is illustrated by the example of Vembedu in the tail-reach, though this tank got filled up every year. The quantum was inadequate for maintaining the duration of supply because of the weak physical condition of the surplus weir (which causes leakage) and because of a reduction in storage capacity (from 4 to 2.5 months) due to accumulation of silt. Because of the short duration of water supply, a majority of farmers in the tail-reach has planted *casuarina* in recent times.

A significant number of (15) tanks report that duration of supply varies between the reaches when the water supply is below normal. The difference is reported to range between 10 to 40 days. This problem is found more in the tanks that got only one filling (adequate to three to four months supply). The land under *mettu madagu* (elevated sluices) and tail-enders are affected more by this problem. It is not reported in a few tanks where rotation system is followed.

Table 4.12: Distribution of Non-system Tanks According to Number of Surplus Filling Years During 1992-94

Sl No	Category of surplus filling	Number of tanks			
		Head	Middle	Tail	Total
1	Never filled up for all 3 years	5	2	–	7
2	Not filled up for 2 years	1	–	2	3
3	Not filled up for 1 year only	1	2	–	3
4	Filled up during all the 3 years	–	4	5	9
	Total	**7**	**8**	**7**	**22**

Note: – Indicates nil.
Source: Field Survey 1995.

Conjunctive Use

Conjunctive use of groundwater is also widespread in the non- system tanks: 17 out of 22 tanks report having wells in their *ayacut*. Nine of them (or about 40 per cent of the tanks) have well density exceeding 50 per hectare. This proportion is roughly the same in the selected system tanks *(Table 4.14)*. But, unlike in system tanks, the density of well irrigation under non-system tanks is much higher in the head reach than in the tail-end. Middle reaches in both categories are relatively poorly served.

None of the tanks with no deficit or low deficit in tank supply report high densities (> 50 per hectare) of wells. Half of those with deficits of 25 to 50 per cent and nearly 70 per cent of those with deficit of more than 50 per cent have well densities exceeding 50 *(Table 4.15)*. Thus in the case of non-system tanks development of conjunctive use seems to compensate for deficit in tank supply. This, as we have seen earlier, is not the case in system tanks.

Structure and Functioning of Organisations

Our survey shows that only two of the selected tanks — one system and one non-system — report having a hereditary, but paid, functionary (*kavaimaniyam*) specifically for tank management. In seven system tanks and nine non-system tanks the responsibility for supervising

Table 4.13: Duration of Water Supply in Non-system Tanks Across Reaches

Sl No	Name of Tank and Reach	Entitlement (months)	Duration of supply Actual months/days			Average for 3 Years (months)	Extent of deficit (%)	Well density (well/100 ha)
			1994	1993	1992			
Head-reach								
1	Kunnathur tank	5	3	1	2	2	60	196
2	Aliyalamangalam eri	6	2	1.5	3	2.16	64	111
3	Pelasur peria eri	7	40*	2	10*	1.22	83	66
4	Ariyathur eri	4	1.5	1.5	3	2	30	59
5	Melcholakuppam eri	6	6	4	6	5.3	11	30
6	Smmiamangalam eri	6	2	2.5	10*	1.61	73	97
7	Kappalur eri	6	3	3	2	2.66	56	72
Middle-reach								
8	Arambakkam eri	6	4	5	4	4.33	28	0
9	Echur Velleri	4	3	2	3	2.66	33	0
10	Adanur peria eri	6	5	5	5	5	17	12
11	Kaliyanur eri	3	2	2	2	2	33	133
12	Edayarapakkam eri	4	3	3	15*	2.16	46	0
13	Valarpuram eri	4	4	4	4	4	0	0
14	Vaiyavoor peria eri	2	1.5	1.5	1	1.33	34	35
15	Vichanthangal eri	4	2	2	1	1.66	58	7
Tail-reach								
16	Sithalamangalam eri	N.A	95					
17	Sirunallur eri	5	6	6	2	4.66	7	45
18	Vilangadu palaya eri 4	9	6	4	6.33	0	0	
19	Keelavalam eri	4.5	4	1	1	2	56	2
20	Vembedu peria eri	4	2.5	2.5	2.5	2.16	46	80
21	Munnuthikuppam eri	4	3	3	3	3	25	7
22	Sengattur peria eri	6	4	3	3	3.33	44	23

Note: * Represents number of days.
Source: Field Survey, 1995.

tank management is taken by *nattanmaikars* (sometimes called *periathanakarars*) along with management of other village affairs.

The *nattanmais* in the three system villages are still held on a hereditary basis by persons from the dominant land owning caste. The incumbents however, are not big landowners. In four others the hereditary system was in vogue till recently but has since been replaced by a system of "elections". Some of these villagers report *nattanmai* functions being performed by groups with more than one person drawn from different castes. 'Elected' *nattanmaikars* are less widespread in the non-system tanks, it being reported only in two of the nine with *nattanmaikar*. In two hereditary *nattanmaikars* manage village affairs

Table 4.14: Well Density in the Non-system Tanks

Reach	Number of Wells/100 hectare of *ayacut*					
	0	1-25	25-50	50-100	> 100	Total
Head	–	1	1	4	1	7
Middle	4	2	1	–	1	8
Tail	1	2	1	2	1	7
Total	**5**	**5**	**3**	**6**	**3**	**22**

Note: – Indicates nil.
Source: Survey, 1995.

Table 4.15: Relation Between Well Density and Extent of Deficit in Tank Supply in the Non-system Tanks

Deficit	Well density					
%	0	1-25	25-50	50-100	>100	Total
0	2	–	–	–	–	2
1-25	–	1	3	–	–	4
25-50	3	–	1	2	2	8
>50	–	2	–	3	2	7
Total	**5**	**3**	**4**	**5**	**4**	**21**

Note: – Indicates nil.
Source: Survey, 1995.

along with reprentatives of other castes presumably by some form of `election'. We could not get more precise information on the nature and basis of "elections".

The hereditary *nattanmaikars* are drawn from several castes. Elected *nattanmaikars* in most cases are made up of several members, drawn from different castes. An attempt is made to ensure that all major castes are represented. *Nattanmaikars* of either kind are not necessarily large landowners but leadership qualities are considered important. The extent of land-owned by *nattanmaikars* varies from 1 to 8 hectares. None of the SC *nattanmaikar* owned any land *(see Tables A4.7 and A4.8)*.

The *nattanmai* system seems to have practically disappeared in the other villages. In 10 system tank villages and 12 non- system villages, it is reported that there is no single recognised person or a group of persons to manage village affairs. Different individuals take initiatives in different matters and at different times. This reflects in the changing social composition of land ownership and greater interest evinced by landowners from non-dominant castes in village affairs. At the same time it points to the weakening or even disappearance of a well-defined locus of authority to make and enforce collective decisions in village affairs.

The *nattanmais/periathanakkarar* are responsible for management of several village related matters (like settling disputes, organising festivals, managing temples) and for mobilisation of resources for these purposes. Matters relating to tank management are also part of their functions except where there is a *kavaimaniyam*. In the past (10-15 years back), according to informants, *nattanmai* were actively involved in the tank-related affairs like implementing *murai* and maintenance of distributary channels. However, their involvement has considerably reduced in recent years because most of the tanks have severe problem in getting supply for even one filling over a long period. The expansion of well irrigation with the advent of electric pump sets and free electricity has also weakened interest in the tank management. Well farmers tend not to cooperate in the tank-related activities.

Lower-level Functionaries

As elsewhere in Tamil Nadu, the field level tasks of tank management are handled by *kammukutties* and *thotties* who are expected to operate the sluices, enforce *murai* or other water rationing procedures, and attend to other work related to tanks as may be assigned by the village authority. As elsewhere in Tamil Nadu the *thotties* also attend to other duties like public announcements by drum beating, passing information regarding deaths and removing dead animals. All lower level functionaries are from the Scheduled Castes (SCs) and mostly landless. They are all hereditary functionaries appointed on rotation basis, the period of rotation depending on the number of families with a hereditary right to do the job. Generally four or five families (sometimes as many as 20) in each village have this right.

These functionaries are found in most (10) system tanks located in the head and middle segments of the basin, even where there is no well-defined village level authority. Three of the system tanks report having one *kammukutti*, the rest has two each. Fifteen of the 22 non-system tanks engage *kammukutties/neerkatties;* four of them have only one of this category of *neerkatties;* eight have two such workers. In most cases they are meant exclusively to attend to tank-related functions. Only two system and three non-system tanks report them to be involved in other village duties.

Another noteworthy feature is that most of the selected system tanks in the tail-end of the basin and a majority of non-system tanks in the head reach have neither a village level authority nor the field level workers. Tank management in such cases is likely to be quite weak. The main reasons for not engaging field workers include: persistent deficiency in water supply received by the tanks; reduction in earnings of these workers due to spread of sugarcane cultivation and development of well irrigation; and dissatisfaction of farmers with work done by these workers. Significantly, unwillingness of SC members to do the work is among the reasons cited: The younger generation in these castes considers the work as demeaning and wages are low.

Remuneration to these workers is given in kind, the rate of payment being specified in terms of bundles of harvested paddy and paddy grain. The rate varies from one bundle of paddy and 6 kg of grain per hectare per season to three bundles and 15 kg per hectare per season. The rate in the head reach seems to be lower than in the middle reach. It is reported that areas where there is demand for labour and the hereditary functionaries are not willing to do the work, the

remuneration rate is higher. In recent times lack of interest among younger people from the communities which traditionally manned these positions has resulted in wage rates being raised recently in some villages. Among non-system tanks, the remuneration to *kammukutties* and *thotties* is generally lower ranging as it does from one bundle and 5 kg (four villages) to four bundles and 20 kg per hectare per season (one village). Four villages report paying one bundle and 8 kg. The rates are lowest in the tail-end; the highest rates are paid in the middle reach *(see Tables A4.9* and *A4.10)*.

MAINTENANCE OF TANKS IN THE PALAR BASIN

Repair and Maintenance by PWD

Information regarding work done by the PWD for repair and maintenance of inlet channels and tank-related structures during the first half of the 1990s are summarised in *(Tables A4.11* and *A4.12)*. It shows that no repairs were undertaken in 12 out of the 18 system tanks and 14 out of 22 non-system tanks. Among system tanks the PWD works were conducted in the head reach (three out of four which reported some repairs), while only two of the middle and one in the tail-reach report some work by the department. Among the non-system tanks, those at the tail-end received more attention than the upper reaches.

In most cases, the PWD did some repairs only once in the last five years. There are only two instances where repairs being taken up twice during the period. Sluice repair and desilting of tankbed are the main items of work done. Other works include repair of surplus weirs, Tank-I and desilting of inlet channel.

Desiltation of the tankbed which usually means clearing silt accumulation in the vicinity of sluices — is reported to have been done in three tanks (two system and one non-system); sluice repairs and four system and four non-system tanks, repairs of surplus weirs in two tanks. The department rarely did desilting of the inlet channels and strengthening of tank *bunds*. Supply channel desilting was reported only in one system tank. Strengthening of tank *bund* was done in one system and three non-system tanks. Considering the derelict state of inlet channel and tank structures, the attention and effort put in by PWD is clearly inadequate. The *ayacutdars* generally complain about both inadequacy and poor quality of repairs undertaken by the PWD.

Repair Works Done by Farmers

Farmers on their own have undertaken repair and maintenance works in several tanks. The major repair works undertaken by them include sluice repair and desilting, construction of small mud-*bunds* on the surplus weir to augment water supply to their tanks, desiltation of supply channel, provision of wooden shutters and lockers for the sluices, strengthening of surplus weirs and *bunds*, removing temporary *kondams* constructed by the upstream farmers, and removal of encroachments in the supply channel. Such works were reported in about half of the tanks (eight system and 12 non-system).

Farmers' involvement in repair works is relatively insignificant in tail-reach of system and head reach of non-system tanks. The most frequent items of work undertaken by farmers related to clearing mud accumulated in the sluices and providing shutters and locks. These works were reported in six system and three non-system tanks. In three tanks (two in system and one in non-system) farmers contributed to raising the surplus weir by using sandbags or constructing mud walls. Farmers in three non-system tanks have undertaken strengthening of tank *bund* during flood emergencies. The reported cash contribution for such works by farmers varies from Rs 150 (for provision of wooden shutters) to a maximum of Rs 6,000 for sluice repairs. Farmers do works like strengthening of tank *bunds*, and raising mud wall on surplus weirs with labour contribution by farmers also.

Maintenance Works Undertaken by the *Ayacutdars*

Apart from the occasional repair works to tank-related structures, farmers contribution to (or participation in) desilting of inlet channels is quite limited: only two system and two non-system tanks report having done this in the last five years. But where it is done the scale of mobilisation is impressive. Thus farmers of Sorpanandal work together, every year, to remove obstructions in their supply channel. Those at the tail-end of the *ayacut* are reported to take much more interest in the work. About 50 persons (consisting of *ayacutdars* and hired labour) participate in this activity twice in a year (before transplanting and after weeding). Some make cash contribution at the rate of Rs25/- per hectare *(Table A4.13)*.

In Butheri, a multi-village tank, desiltation of the inlet channel is done regularly by the *ayacutdars* of both villages. This is done every year before opening sluices for irrigation. About 80 farmers in both villages are involved in this work. There is no institutional arrangement in one of the villages. But the *kavaimaniyam* of the other village made effort to organize the *ayacutdars* of both villages. As soon as water flows into the channels, the *kavaimaniyam* mobilises farmers. They go to the head of the inlet channel for desiltation so as to facilitate smooth flow. The basis of contribution is mainly labourers. The entire *ayacut* is divided into five equal parts and handed over to five divisions in order to avoid free riding by any of the farmers. The extent of participation was reported to be good. There was no

need to invoke the provision for imposition of fine for non-participants.

Farmer participation in maintainence of main and field channels, though variable is more widespread than in desilting inlet channels. Thus out of the 18 system tanks, farmers did not do any work on main channels in six; but in nine they did this work regularly every year. Among non-system tanks about a third did not do any work on distribution channels but those who undertook the work, did it regularly. Lack of interest and participation in maintenance of distribution channels basically reflects meager water supply in the tank, which makes it not worthwhile to expend efforts on this activity. In some cases siltation and encroachment of distribution channels is cited as the reason. It appears that the farmers in the middle reach take more interest in desilting channels and do it more regularly in both categories of tanks. The participation is more widespread and work is done more regularly in non-system tanks *(see Table A4.14)*.

In few tanks (one system and three non-system) the de-siltation of the main/branch channels has been done more than once a year. For example, in Vichanthangal (non-system) tank, this work has been done by the farmers four times a season before sluice opening, during transplantation, after weeding and at the end of the supply period. This tank happens to have a kavaimaniyam who takes active interest in helping farmers to use the available water efficiently. In some cases (e.g., Thirumangalam tank) farmers lost interest after 1986 due to encroachment of field channels. Low participation in Melcholakuppam Peria eri is due to the fact that it is a newly constructed tank where the branch and field channels are yet to be excavated. In one case (Adanur) abandonment of cultivation and conversion of agricultural lands to house sites has made maintenance irrelevant.

The time of desilting of main/branch channels varies. In four tanks the main channels were desilted after weeding, the in two it was done after transplantation itself. In some other tanks the work is done even before opening of the sluices. In one tank it is done only at the end of the season when there would be scarcity of water. The reasons for this variation are not clear.

Extent of Participation

In a majority of tanks maintenance of distribution network by *ayacutdars'* is reported to be satisfactory. The magnitude of labour input for maintenance of inlet and distribution channels ranges from a fraction of a man-day per acre to three mandays per acre. The input is much less in non-system tanks and seldom exceeds one man-day per acre. In most cases the labour is contributed by *ayacutdars* themselves. In some, they contributed cash in lieu of own labour; the cash is used to hire workers.

Labour contribution on household basis is predominant in both system and non-system tanks. One person/household is the norm in many tanks: seven each in system and non-system tanks. In one system tank two persons/acre is fixed as the norm. Another prescription is one person/per acre. In two tanks cash contribution is made for desilting the branch and other channels with hired labourers. The rate of cash contribution is Rs 10 per household in one system tank and Rs 10 per acre in two tanks (each one in system and non-system). In one of the non-system tanks the cash contribution is fixed as Rs 25 per household. Some tanks (one system and four non-system) have no prescribed norms for contribution: only those interested (head and tail-reaches) persons participated in the desilting works.

Efforts Made by the *Ayacutdars* to Improve the Tank Supply

The *ayacutdars* under the selected tanks adopt several methods to improve the water supply: Constructing mud *kondams* in the riverbed, removal of obstacles in the supply channel, constructing mud wall on the surplus weirs to raise the FTL, interactions with PWD/higher level authorities by sending petitions and representations, using political influence and agitation. For instance, in Nandhimangalam about 100 farmers used to go to the Beemanadhi river and construct mud-*bund* (*kondam*) to divert water to the supply channel as the level of the riverbed is about two feet lower than that of the supply channel. As the water supply available is already meager due to illegal diversion by upstream *ayacutdars*, the construction is necessary every year to trap the available water. Appeals to the collector and PWD officials to find a permanent solution have not been successful.

In Valayampattu tank, about 50 farmers used to go to the head of the supply channel to remove the temporary structures constructed by the upstream tank farmers in the river. They also have reported this problem to PWD and revenue officials. A case has also been filed in the Chengam taluk court against such illegal obstruction. The farmers under four non-system tanks construct a mud-wall on the surplus weirs every year so that more water to be stored in their tanks. About 15-25 persons participated. This is said to be necessary in view of the reduction in effective storage capacity of the tanks and damaged conditions of the surplus weirs. In Thirumangalam eri farmers are reported to have got involved in 1992 and demolished a house constructed in the foreshore area.

It is evident that apart from allocation of water from the tank, the farmers' organisation has also participated in improving the supply to their tanks. As this is comparatively difficult operation, only a few tank *ayacutdars* are involved. This also requires intervention of the higher level authorities and cooperation among different villages.

Effect on Groundwater

Variations in density and potential supplies of groundwater are influenced in a significant measure by the tank water supply. The larger the volume and the longer the duration of tank supply, the larger is the potential for conjunctive use. This suggests that class II tanks may be better placed in this respect. The majority of head and tail-reach system tanks are in this category and the well-density is also generally high in these segments. The middle reach tanks are mostly class IV and well density is also low. Among non-system tanks the proportion of class II is highest in the head reach, followed by the middle reach. There is no class II tanks in the tail-end. The well density also roughly corresponds to this ordering.

However, we have seen that actual water supply in most cases are short of expectations. In several cases (e.g., Thimmasamudhram, Muttavakkam and Elangadu among system tanks and Semmiamangalam and Keelavalam among non-system tanks) wells yield little because the tanks have not been filled for several years continuously since the early 1980s. In many others, recharge must have been adversely affected by siltation of tank and reduced supplies, both of which are reported to be widespread. In several others, unfavourable geological conditions (rocky sub-strata) limit the recharge.

Eight of the selected tanks (three system and five non-system) do not have any wells mainly because of unfavourable geological conditions such as sandy soil, which do not permit well construction, poor water quality and deep water table (100-400 feet). By contrast, in Vichanthangal the proximity to Palar river greatly enhances the potential for tapping good water, even if tank supplies are inadequate.

Differences in density of wells of course do not necessarily reflect differences in the quantum of groundwater use or the area benefited. It was not possible to get much information on well yields or area irrigated per well. But it is widely reported that the number of wells has increased specially since 1980 and that this has been accompanied by a progressive lowering in the groundwater table (currently ranging from 12-85 feet in system tanks and 20-70 feet in non-system tanks). Wells yielding adequate water supply for raising even one or two crops are said to be very limited.

Effect of Wells on Organisation and Maintenance of Tanks

The effect of wells on farmer's organisation and tank-related activities is noticeable in three system tanks (Sogathur, Nallur and Ponneri) in the tail-reach and four tanks in non-system (Kappalur HR, Sithalamangalam, Vembedu and Sengattur TR). Well owners in the above said tanks are reported to have become indifferent to participation in desilting operation in the main/branch/field channels below the outlet after 1989 when electricity for pumping became practically free.

The increase in the area under sugarcane cultivation in some tanks, facilitated by access to well water, has also been a contributory factor. When sugarcane became a major crop, irrigation workers of tanks lost their interest due to non-payment of wages by the well owners in recent times. However, several villages (viz. Kottakulam, Butheri, Melpadi among system tanks and Vaiyavur, Sirunallur, Keelavalam, Munnuthikuppam and Vichanthangal in the non-system category) report active participation of well owners also in desilting operation and organisation mainly because of the dedicated involvement of the irrigation functionaries. Also, the farmers under these tanks are dependent more on tank water than well water because of lowering of groundwater table.

RESOURCES OF TANK ORGANISATION

The resources needed for maintenance and operation of tanks are obtained in one or more of the following ways: Drawing on the common village fund, levies on ayacutdars for specific tank-related activities (maintenance, major repairs, persuading government officials), and payments made by *ayacutdars* to *kammukutties* and *thotties*. The village fund is made up of revenue from auctioning of fishing rights in the tank, duck grazing and auctioning of trees fines, and donations for temple festivals and special occasions. Expenses of temple festivals and common activities of the village as a whole are usually met by village fund. They are sometimes also used to meet tank repairs. Some villages earmark revenue from fishing and duck grazing rights for tank. Such mobilization is however not done by all villages. Thus majority of system tanks (12 out of 18) have neither a village nor a tank fund *(see Table A4.15)*.

These are usually marked by weak village organisation: most of the villages in this category do not have *nattanmaikars* (elected or hereditary). Of the six system tanks which report having funds, two use the collections exclusively for village purposes (mainly temple festival), three are for both village and tank, and one is exclusively for tank. The amount reported to be available in these funds varies between Rs 150 and Rs 10, 000.

A large proportion of non-system tanks (10 out of 22) maintain village or tank funds ranging from Rs 300 to Rs 10,000. These are all in the middle and tail reaches. None of the head reach tanks maintain such funds. (Significantly none of them have functioning

village organisations). Periodic auctioning of trees (five villages) and duck rearing (seven villages) are most frequently reported sources. In one case a big farmer contributed towards construction of a *kondam* on the surplus weir. A majority of the villages treat these as village funds, but allow them to be used for tank related expenses. Only four of the 12 tanks with these funds earmark it exclusively for tanks *(Table A4.16)*.

Ayacutdars contribute to tank-related expenses, in the form of labour or cash, at prescribed rates for maintenance of inlet and distribution channels and also for special work in emergencies to repair major damage. In 1994-95, 12 out of 18 system tanks reported labour contributions ranging from 20 person days to 300 person days for maintenance of common facilities. *Ayacutdars* of 14 of the 22 non-system tanks contributed labour (mostly own labour) ranging from 20 to 480 person days. While the proportion of tanks reporting *ayacutdars* contribution for the above purpose is somewhat higher among non-system tanks, the extent of labour spent (own plus hired) per hectare of *ayacut* in this category is less than in system tanks. In seven out of 12 system tanks the labour input exceed 100 person days. Comparable figures for non-system tanks being only 5 out of 14 *(see Tables A4.13* and *A4.14)*.

Ayacutdars' contribution to major repairs of *bunds*, sluices and surplus weirs is also significant. As many as 12 system tanks reported contributions for this purpose (ranging from Rs 200 to 6,000) during the last five years; but only four did such work during the year of the survey. The non-system tanks also report special repairs in the last five years, most of them being done during 1994 and 1995. The contributions are mostly in labour whose magnitude however could not be ascertained.

Ayacutdars are also expected to pay (in the form of straw and grain) the *kamukutties* and *thotties* in every season. As already reported the prescribed rate of payment varies across tanks. It is difficult to know from a rapid survey whether these rates are in fact paid regularly and by all *ayacutdars*. But if they did, the payment is substantial: the value of grain payments ranges from Rs 35 to Rs 135 per hectare.

WATER ALLOCATION IN THE SELECTED TANKS UNDER PALAR BASIN

In this section, we discuss about the role of irrigation organisation in allocation of water available in the tank, especially the turn system if any and its effectiveness in the equitable distribution of water both during normal and scarcity times. Discussion is also made about the collective action in the appropriation/distribution of water at the tank level.

Table 4.16: Characteristics of Selected Palar Basin Tanks Grouped According to Level of Activeness of Institutions

Score for intensity of activeness	No of tanks	Characteristics of												Single caste domination	Deficit		
		Water supply			Location			Variability			Well density				< 25	25–50	> 50
		1	2	3	H	M	T	H	M	L	H	M	L				
System Tanks																	
5 or less	11	8	3	–	2	3	6	3	7	1	3	4	4	8	3	1	7
6 – 8	4	4	–	–	–	3	1	2	2	–	1	–	3	1	1	–	3
9 –11	2	–	2	–	2	–	–	–	–	2	–	1	1	2	2	–	–
>12+	1	1	–	–	–	1	–	–	1	–	–	–	1	–	–	–	1
Total	**18**	**13**	**5**	**–**	**4**	**7**	**7**	**5**	**10**	**3**	**4**	**5**	**9**	**11**			
Non–system Tanks																	
5 or less	12	9	1	2	6	3	3	5	4	2	6	2	4	9	4	2	6
6 – 8	5	4	–	1	1	2	2	1	3	1	–	1	4	2	1	3	1
9 –11	3	1	1	–	–	2	1	–	1	2	–	1	2	1	1	1	1
>12+	2	1	1	–	–	1	1	–	1	1	–	–	1	1	2	–	–
Total	**22**	**15**	**3**	**3**	**7**	**8**	**7**	**6**	**9**	**6**	**6**	**4**	**11**	**13**			

Note: Water supply: 1,2,3 indicate availability of water supply by months. Location; H = Head, M = Middle; T = Tail; Well Density: High (1–50 = 1); Medium (50–100 = 2); Low (> 100 = 3); Variability: Minimum supply/Maximum supply; H = High (< 40%); M = Medium (40–80%); L = Low (> 80%); – Indicates nil.

Source: Field survey, 1995.

Regulation of Water

During the normal periods, the available water in a majority of system tanks (10 out of 18) is regulated by *kammukutties* and *thotties* on the basis of instructions from village *nattanmai* (or equivalent authority) where available, or where they do not exist (and this is mostly the case in tail-end tanks) on the representation by a group of farmers. Some times the lower level functionaries themselves undertake the work on the basis of their experience. However, in six tanks, which do not have *kamukutties* or *thotties,* the *ayacutdars* themselves undertake this work, but this is reported to be not very effective. There are systematic variations across reaches in this respect. Broadly speaking, this function is perhaps managed best in middle reach tanks most of which have both well-defined village leaders and irrigation workers.

Date of Release of Water

In tanks where there are control structures, the date of water release is decided at meeting of *ayacutdars* convened by the *nattanmai.* The irrigation workers are also appointed at this meeting. Generally the date of release is decided on the basis of storage position and the trend of rainfall just before sowing time. In tanks where there are no control structures, such decision is not possible. Hence farmers start the cultivation as soon as water begins flowing into the tank. Tail-end tanks whose supply is relatively meager and uncertain and where no well-defined village organisation is operative, there is no collective decision making on this issue.

The agricultural operations generally vary from tank to tank across reaches based on the water availability. Water was not at all released in some tanks when the storage available is very low. For instance, during 1994-95, water was not released from Ponnur eri due to meager storage (1.5 months) and it was utilised for the recharge of the wells. Also in Singlipadi eri, the water was not released from the tank during 1992-93 and 1994-95 for the same reason, as there was water for only seven to 15 days *(see Table A4.17).*

If the tanks get reasonable supply, the *ayacut* under *mettu madagu* could get water supply for short periods; otherwise it is very difficult to get water supply. Majority of the selected system tanks reported that because of the short duration of supply in the tanks, water could be used only by the *palla madagu* head reach *ayacutdars.*

Methods of Water Allocation During Scarcity Periods

Ration by acreage and crop: During normal period, there is no attempt to regulate the area of crop sown or its timing by the farmers under the selected system tanks. Most tanks do not attempt any regulation in these respects even when initial storage is inadequate. Only three tanks (two in the middle and one in tail) have to regulate area under crop sown/timing. Thus in Singlipadi *eri,* the area under crop sown was restricted to 0.25 acre per farmer to raise only dry crops (like *ragi*) during 1994 when there was scarcity. *Nattanmais* took the decision in consultation with *ayacutdars.* It is reported that it worked well due to the effective functioning of the *nattanmaikar* and collective effort. But in the case of Mahadevimangalam eri efforts to restrict the area sown to 200 acres during 1993-94 (out of a registered *ayacut* of 270 acres) could not succeed due to weak village organisation and lack of cooperation from farmers. In Elangadu Peria eri we found another type of response to water scarcity at sowing time: Though this tank does not have any effective village organisation, the farmers under this tank raise *pulithi kar* (*vaigunda*) under broadcast sowing when tank storage at sometimes is low.

Ration by turn system: Even when tank storage falls below requirement — and this happens often towards the end of the season because of inadequate storage or poor rainfall or both — most tanks do not resort to any rationing. Only five tanks (one each in the head and tail and three in the middle reaches) report following collective rationing. There are different types/methods used for rationing: (i) *Oru madai paichal;* (ii) *Murai* with time; and, (iii) Tail-to-head irrigation.

Under *oru madai paichal,* water is supplied to only one channel at a time. This was adopted in Kottakulam Palaya eri (HR) during 1987 and 1991. The available water was supplied to each channel once in four days in rotation. Coolies were appointed to supervise and regulate watering and to help the *thotti* in this task. When rationing is in force, farmers are not allowed to irrigate fields on their own. The system reportedly worked well in 1987 only when a single person (hereditary *nattanmai*) was involved in the management of the tanks but failed in 1991 because the old *nattanmai* passed away and village leadership became weak.

The Singlipadi eri adopted a variant of the *oru madai paichal* in 1993-94 whereby water was supplied to one channel at a time starting with the tail-end and moving up to the head. This rotation was applied mainly to area under the deepest sluice. *Thotties,* as advised by the *nattanmais,* did the watering. Overall the system worked well. During 1994-95 this tank adopted *murai* system to utilise the available water from dead storage. Farmers (mostly from the head-reach) were allowed to pump for three hours per day by using oil engines.

The Butheri tank uses a *murai* system during transplantation; under this system, the entire *ayacut* is

divided into five divisions and water is given to each. In case some field faces severe scarcity, it is given water supply even if it is not eligible as per the rotation at that time. Once the *murai* system is announced, farmers are not allowed to do irrigation of their own but only *kammukutties* are to irrigate the fields. If there is any violation, a fine of Rs 100 is levied. It is reported that the system has worked well due to active involvement of *kavaimaniyam*.

In Melpadi Sitheri, a multi village tank, *murai* with time is adopted to ration supply between the two villages when the available water in the tank is adequate for about 15-20 days. Under this, a turn system for 36 hours is adopted among the farmers. The turn period of 36 hours is divided in to three parts of 12 hours each. It is also specifically agreed that the *ayacutdars* of the tail-end village will always have night irrigation only as it will help them to get uninterrupted water supply from the head reach. Under this system, the farmers themselves implement the rotation and *thotties* are employed for opening and closing of the sluices. The system is reported to have worked well.

Disputes in Allocating Water

Disputes are common in all the tanks — both with upstream tanks and farmers along the inlet channel as well as among the *ayacutdars* of each tank. Investigation of the incidence and nature of the disputes was found difficult even in more intense and prolonged surveys. The disputes are reported to be mild, but they are sorted out locally. There are few instances of inviting police help for going to courts. However, we did get some details of disputes in three cases, which are suggestive.

In Nandhimangalam eri (HR), the dispute is between two communities (Boyar and Naidu) within the village. The Boyars lands, being concentrated in the head-reach, are advantageously placed to use water. They used to lock the shutters and not allow water to flow down. This led to breaking of locks during night. Removing the locks and Boyars agreeing to irrigate during day-time only solved the dispute. Disputes also exist between this tank and its upstream tank because the latter illegally constructed a concrete wall across the river.

In the Muttavakkam tank conflicts arose in 1977 and 1985 with an adjacent village who had encroached the tankbed. It became serious when the latter cut open the *bund* to avoid flooding of land encroached by them. The police also registered a case. Eventually the problem was resolved locally by a compromise.

In Elangadu peria eri, there used to be frequent quarrels with the upstream tank farmers (Soraputhur eri) over illegal raising of height of the surplus weir by them. The surplus weir of the upstream tank has been raised for about two feet by a temporary mud wall, which affected the water supply to the downstream Elangadu eri. However, the dispute has reportedly been settled locally by elders and neighbours.

None of the non-system tanks attempt to regulate either the extent or timing of sowing operations in the light of tank storage. None of them attempt any rationing during normal supply during the crop season. Even when supplies during the crop period fall short of requirements, none of the selected tanks in the head reach adopt any rationing. They neither have the necessary village organisation or the personnel for this purpose. About half the tanks in the middle and tail segments do report the rationing when they have a functioning *nattanmai* assisted by *thotties/kammukutties (Table A4.18)*.

Generally, the rotation system is introduced in the water level in the tank which has decreased to the level of a month's supply. At that time, the higher level functionaries conduct meeting with the farmers to decide on introducing rotation. Two types of *murai* systems are in vogue: *orumadai paichal* and *pangu* system. As elsewhere, *orumadai paichal* allows water supply in only one channel at a time. This method is reported to be in use in five tanks. Some (*eg*, Valarpuram eri) follow a system of channel-wise rotation from head to tail. In some others (eg, Keelavalam) the rotation is from tail to head. *Sirunallur* rotates supply between the sluices when rotation is in effect done by *kammukutties* under supervision of *nattanmais*. Some tanks irrigate only during the night in order to reduce water loss. The system is reported to work well when there is a strong village leadership and it takes active interest in tank management.

***Pangu* system**

Besides *oru madai paichal*, three tanks adopted *murai* based on *pangu* system. In the case of Vichanthangal eri there are 14 *pangus* (or shares). Each *pangu* consists of two to four farmers. Each farmer under a *pangu* will get water supply for 1 hour 12 minutes only. The same person will get water supply again after two days only depending upon the water availability. The order of priority is decided by drawing lots. Only the *pangu* holders use the water during the scarcity periods. Moreover, they also have the right to sell or exchange their water rights with other farmers who need more water. The *kammukutti* takes the responsibility of watering the field as advised by the *kavaimaniyam*. Irrigation is done during nighttime also and, it is said that it worked well without any problem due to the active involvement of hereditary *kavaimaniyam* and also, through the collective efforts by the users.

Disputes in Allocating Water

Disputes are common in most (14) of the tanks. Disputes within the *ayacut* are usually settled locally by introducing systematic rationing and where the rationing is ineffective the disputes are settled through mediation by village elders. Inter village disputes usually arise on account of excessive diversion of water or illegal appropriation by upstream villages. Thus the Pelasur peria eri has frequent quarrels with upstream of Ladavaram village on this account. A court case was filed on this about 30 years ago. Though the court decision favoured Pelasur, the problem still persists.

Efficiency of Tank Organisations in the Palar Basin

In the foregoing account, we have seen that there are local-level institutions to take care of tank-related issues in the Palar basin. These informal organisations are important in the context of the viability of PWD to maintain the system and manage water allocation effectively. We have seen that though the condition of most tanks is unsatisfactory they are not abandoned, thanks to the efforts taken by these informal organisations. However, there are significant variations between the tanks as regards the effectiveness of these organisations.

The effectiveness of institutions is assessed in terms of the intensity of effort put into maintenance of irrigation structures, presence of *neerkatties* and *thotties* for water distribution during scarcity times, which together determine the quality of tank water supply. As noted earlier, there are differences in the efficiency of organisation across tanks in fulfilling these two functions. To measure the relative effectiveness of the institutions, we have adopted scoring procedures as used in the study of the tanks in the Periyar-Vaigai basin. The details about the functions undertaken and

Table A4.1: Technical Characteristics of the Palar System Tanks, 1995

Sl No	Name of tank	Reach	Zone	Class	Single/multi village	Single crop	Double crop	Registered *ayacut* (hecta	
								PWD	Rever
1	2	3	4	5	6	7	8	9	10
1	Nandhi-Mangalam eri	HR	UC	IV	1	69.85	1.50	71.35	71.3
2	Kottakulam palaya eri	HR	UC	IV	1	86.05	–	87.01	86.0
3	Sorpanandal eri	HR	UC	IV	1	63.38	11.79	53.34	75.
4	Valayampattu eri	HR	UC	IV	1	142.78	18.02	178.47	160
5	Singlipadi eri	MR	LP	IV	1	58.68	–	58.68	58.6
6	Mahadevi-mangalm eri	MR	LP	III	1	105.63	–	112.29	105.6
7	Butheri	MR	LP	II	2	N.A	N.A	151.36	242.9
8	Muttavakkam eri	MR	LP	IV	1	95.11	–	135.98	95.
9	Thimmasamudram periya eri	MR	LP	IV	1	302.61	–	298.26	302
10	Thirumangalam periya eri	MR	LP	IV	1	52.81	6.49	59.49	59
11	Thenampakkam periya eri	MR	LP	IV	1	143.15	42.10	226.23	185.2
12	Ulundai	TR	KR	II	1	119.22	16.14	134.77	135.3
13	Sogathur eri*	TR	KR	IV	1	22.72	40.00	62.36	62.7
14	Nallur peria (hissa) eri	TR	KR	II	2	111.02	64.59	248.08	175
15	Melpadi sitheri	TR	KR	II	2	53.56	17.72	99.96	71.2
16	Keelsatha-mangalam eri	TR	KR	II	1	29.42	123.14	194.26	152.5
17	Elangadu peria eri	TR	KR	II	1	161.92	45.82	209.45	207.4
18	Ponnur peria eri	TR	KR	II	1	69.77	58.60	140.43	128

Note: HR = Head reach; MR = Middle reach; TR = Tail-reach; UC = Upper Cheyyar; LP = Lower Palar; KR = Kiliyar; NA = Not Available; FCA = Free Catchment
* In actual it is a rainfed tank, but according to PWD it is classified as system tank; Column 12 as per farmers experience; FCA = Free Catchment Area; –
Class I = > 9 months; Class II = 6-9 months; Class III = 3-6 months; Class IV = < 3 months (for more details see GO no 250 I, PWD, GOM, 3-6-1914).

Source: Village "A" Register and Tank Memoirs.

the scores obtained by organisations in different tanks, on the basis of this scoring scheme are given in the Annexure to this chapter *(Table A4.19)*.

In the large majority of selected tanks (11 out of 18 system tanks and 12 of the 22 non-system tanks) community management is very weak. Only 3 of the system and 5 of the non-system tanks have very or moderately active institutions. There is a relatively higher concentration of less active institutions in the tail-reach system tanks; but among non-system tanks these are more frequent in the head reach. The characteristics of system tanks in relation to activity of institutions are set out in *Table 4.16*. The two moderately active system tanks reporting more assured supplies for three to six months are located in the head-reach; and have low to medium well density. Both are single-caste villages. But the most active tank is a multi-caste tank, located in the middle reach getting less than three months supply with medium variability and low well density. Tanks with weak institutions are mostly in the middle and tail-reaches. A large majority of them get less than three-month supply with moderate to high variability and medium-high well density.

Among non-system tanks those with least active institutions show a relatively high incidence of poor supply (three months or less) and more variable supply, and high well densities. This configuration is expected to weaken incentives for collective management. Among moderate and very active tank communities a large proportion get supplies for 3-4.5 months, report relatively more assured supplies and low well densities. Thus water supply conditions seem to be a significant factor in explaining differences in intensity of community effort. Location and caste seem much less influential. ■

pacity (Months)		Storage capacity (MCM)	Capacity/ha of *ayacut* (MCM)	WSA (ha)	WSA/ ha of *ayacut*	FCA area (sq miles)	FCA/ ha of *ayacut*	Sources of Supply
langal	Actual							
11	12	13	14	15	16	17	18	19
3	2	0.528	0.007	58.45	0.82	0.88	0.01	Beemanadhi
3	3	0.455	0.005	66.81	0.78	0.54	0.01	Cheyyar
3	3	0.211	0.003	62.26	0.83	2.2	0.03	Cheyyar
3	3	1.784	0.011	60.05	0.37	3.9	0.02	Cheyyar
3	3	0.074	0.001	13.01	0.22	0.13	0.00	Kambakkal channel
4	3	0.561	0.005	67.01	0.63	0.74	0.01	Kambakkal channel
6	6	2.422	0.010	362.61	1.49	2.82	0.01	Vegavathi river & surplus water from Ambi eri
4	3	0.238	0.003	23.23	0.24	0.75	0.01	Kambakkal channel
4	3	0.594	0.002	2.83	0.01	0.94	0.00	Aripakkam velleri
4	3	0.419	0.007	56.56	0.95	3.47	0.06	Kambakkal channel
4	3	1.653	0.009	4.45	0.02	0.59	0.00	Palar
6	4	0.619	0.005	68.88	0.51	1.5	0.01	Cheyyar *anicut*
4	3	0.546	0.009	48.82	0.78	1.5	0.02	Gets water supply from Odai only
6	6	0.944	0.005	244.39	1.39	10.41	0.06	Surplus water from Theyyar eri and drainage water from Uthukulam and Madam eri
8	6	1.328	0.019	56.86	0.80	1.9	0.03	Surplus water from Vallam eri (3 kms) and Peria eri of this village
8	7	1.821	0.012	62.72	0.41	1.8	0.01	Surplus and drainage waters from 5 upstream villages
8	6	3.057	0.015	143.67	0.69	1.03	0.00	Surplus water from Soraputhur & rainwater (4-5 kms)
6	5	2.050	0.016	136.19	1.06	3.2	0.02	Vember's surplus water & rainwater

Table A4.2: Technical Characteristics of the Palar Non-system Tanks, 1995

Sl No	Name of tank	Reach	Zone	Class	Single/Multi village	Single crop	Double crop	Registered *ayacut* (hectr	
								PWD	Rever
1	2	3	4	5	6	7	8	9	10
1	Kunnathur Hissa tank	HR	UC	III	2	87.60	3.89	129.10	91.4
2	Aliyalamangalam Peria eri	HR	UC	II	1	112.88	–	112.51	112.8
3	Pelasur Peria eri	HR	UC	II	2	136.70	29.39	165.60	166.0
4	Ariyathur eri	HR	UC	III	1	63.73	8.03	72.21	71.7
5	Melcholakuppam Peria eri	HR	UC	II	2	N.A	N.A	241.20	250.7
6	Semmia-mangalam eri	HR	UC	II	1	72.90	–	73.10	72.9
7	Kappalur eri	HR	UC	II	1	116.50	97.60	239.70	214.3
8	Arambakkam eri	MR	LP	II	1	N.A	N.A	83.77	83.7
9	Echur velleri	MR	LP	III	1	48.21	50.72	244.84	98.9
10	Adanur Peria eri	MR	LP	II	2	N.A	N.A	210.85	209.4
11	Kaliyanur eri	MR	LP	IV	1	41.40	19.00	110.12	60.4
12	Edayara-pakkam eri	MR	LP	III	1	N.A	N.A	220.56	236.9
13	Valarpuram eri	MR	LP	III	1	72.98	32.99	106.03	105.9
14	Vaiyavoor Peria eri	MR	LP	IV	1	N.A	N.A	175.64	185.4
15	Vichanthangal eri	MR	LP	III	1	40.87	–	40.87	40.8
16	Sithalamangalam Peria eri	TR	KR	IV	1	52.81	–	46.95	52.8
17	Sirunallur eri	TR	KR	III	1	55.06	–	55.04	55.0
18	Vilangadu Palaya eri	TR	KR	III	1	100.39	15.14	104.28	115.5
19	Keelavalam eri	TR	KR	III	1	123.76	–	105.63	123.7
20	Vembedu Peria eri	TR	KR	III	1	215.39	8.58	222.99	223.9
21	Munnuthi-kuppam eri	TR	KR	III	3	106.07	–	106.03	106.0
22	Sengattur Peria eri	TR	KR	II	1	N.A	–	202.24	202.3

Note: HR = Head-reach; MR = Middle-reach; TR = Tail-reach; UC = Upper Cheyyar; LP = Lower Palar; KR = Kiliyar; NA = Not Available; FCA = Free Catchment Area; * In actual it is a System tank, but according to PWD it is classified as non-system tank; Column 12 as per farmers experience; FCA = Free Catchment Area; –' = Nil. Class I = > 9 months; Class II = 6–9 months; Class III = 3–6 months; Class IV = < 3 months (for more details see GO no 250 I, PWD, GOM, 3–6–1914).

Source: Village "A" Register and Tank Memoirs.

acity (Months)		Storage capacity (MCM)	Capacity/hec. of *ayacut* (MCM)	WSA (Hec)	WSA/ hectare of ayacut	FCA area (Sq.miles)	FCA/ hectare of *ayacut*	Sources of supply	Chain (C) Isolated (I)
angal	Actual								
11	12	13	14	15	16	17	18	19	20
5	3	0.058	0.001	N.A	N.A	2.05	0.02	a) Surplus water from Sitheri and rain water from Thenmalai through separate channel (3 kms)	C
6	5	1.566	0.014	N.A	N.A	2.3	0.02	a) Gets surplus water from pernam-pakkam eri (4 kms) b) Rain water from reserve forest	C
7	5	2.590	0.016	N.A	N.A	4.6	0.03	a) Gets surplus water from Sora-kolathur eri (12 kms) b) Drainage water from Pathiavadi	C
4	3	0.401	0.006	N.A	N.A	0.31	0.00	a) Surplus water from Thirumalai eri through *kalvai* (5kms)	C
6	6	1.114	0.004	N.A	N.A	9.13	0.04	Rainwater from Vannathi odai and Poongavanam odai (5 kms)	I
6	6	1.147	0.016	N.A	N.A	1.8	0.02	Drainage water from Randam and Ejamanthangal peria eri etc.	I
6	4	2.571	0.012	N.A	N.A	2.04	0.01	a) Upper Cheyyar anicut and rain water from Chinnamalai	C
6	4	0.587	0.007	62.53	0.75	1.21	0.01	Surplus water from Orathur tank	C
4	3	0.666	0.007	53.43	0.54	1.29	0.01	Rainwater from two *odaies*	I
6	5	2.090	0.010	108.42	0.52	1.27	0.01	Surplus water from Kooduvancheri tank	C
3	3	0.481	0.008	55.75	0.93	0.58	0.01	Surplus water from the upstream tank	C
4	3	1.365	0.006	140.64	0.59	3.71	0.02	Surplus water from the upstream tank	C
4	3	0.793	0.007	66.44	0.63	6.71	0.06	Rainwater flows through *odai*	I
2	1.5	0.894	0.005	1000	5.39	1.16	0.01	Surplus water from the upstream tank	C
4	3	0.163	0.004	27.88	0.28	0.65	0.01	Rainwater from Vellavari channel	I
N.A	N.A	0.256	0.005	74.5	1.41	1.44	0.03	Rainwater flows through five *odaies*	I
5	4	0.594	0.011	134.27	2.44	1.42	0.03	Rainwater through Vellakalvai	I
4	4	0.014	0.000	34.4	0.30	6.05	0.05	Rainwater through Vellakalvai	I
4.5	4	0.863	0.007	89.99	0.73	0.82	0.01	Surplus water from Thottanavalur eri	C
4	2.5	0.528	0.002	N.A	na	6.65	0.03	Rainwater through Vellakalvai	I
4	3	2.110	0.020	10.8	0.10	0.22	0.00	Surplus water from the upstream tank	C
6	4	1.729	0.009	39.81	0.20	8.43	0.04	Surplus water from the upstream tank	C

Table A4.3: Conditions of Physical Structures in the Palar System Tanks, 1995

Tank Sl No	Inlet channel			Tank *bund*	
	Good	Encroached feet/km	Silted	Good	Breached
1	2	3	4	5	6
Head-reach tanks					
1	No	Width :- original:30' current:8'	Depth:- original 10' Current 3'	No	All are in bad condition
2	No	Width :- original:25 current:12	Depth:- original: 20' Current:10'	No	Entire stretch
3	No	Width :- original:9 current:3	Depth:- original: 7' Current:2'	No	Nil
4	No	Encroached/constructed 20 houses	About 6kms length is fully silted	Yes	Nil
Middle-reach tanks					
5	No	Width :- original:40' Current:30'	Depth:- original: 8' Current:3'	No	Breached in three places
6	No	Width :- original:15' current:8'	Depth:- original: 2' Current:1/2'	No	Breached in four places (40'-60') near the sluice
7	No	3 kms fully encroached since 1966	Fully silted (about 20')	No	Breached in many places for about two furlong distance
8	No	Entire supply channel is encroached since 1985	Fully silted due to encroachment.	No	Breached in five places for about 200'-250'
9	No	About 0.8 km encroached by local people since 1975.	Fully silted due to encroachment.	Yes	Nil
10	No	> 40% of supply chl. is encroached by the same villagers.	About 3'	No	Breached in three places
11	No	About 10 kms is encroached for house construction.	Fully silted	Yes	No
Tail-reach tanks					
12	No	Width :- original:15' current:6'	Depth:- original:6' Current:2'	Yes	No
13	No	Width :- original:10' current:5'	Depth:- original:5' Current:3'	No	About 10' breached in the centre place
14	No	Width :- original:10 current:3'	Depth:- original:3' Current:1/2'	No	About 60'
15	No	Width :- original:40' current:20'	Depth:- original:20' Current:5'	No	Breached in two places for about two furlongs.
16	No	Width :- original:40' current:10'	Depth:- original:5' Current:2'	No	Breached in three places for about one furlong.
17	No	Width :- original:25' current:10'	Depth:- original:5' Current:3'	No	Breached in three places for about 25'-60'
18	No	Width :- original:20' current:10'	Depth:- original:6' Current:3'	No	Breached in five places for about 30'-50'

Note: – Indicates nil.
Source: Interviews conducted with experienced farmers and *thalaiyaries*, 1995.

Tankbed				Sluices and control structures				Surplus weir			Remarks
Siltation (feet)			Encro ached	Total No	Good	Dama-ged	No shutters	Total No	Good	Weak	
Heavy		Not much									
8	9		10	11	12	13	14	15	16	17	18
About 4	–		About 4 acres (past 10 years)	3	2	1	3	1	1	–	Due to bad condition it is abandoned
About 5	–		About 20 acres (past 15 years)	3	3	–	–	2	2	–	–
About 5–6	–		About 60 acres (past 20 years)	3	2	1	3	2	1	1	Palla madagu is Damaged fully causing water leakage
Yes	–		Nil	2	–	2	2	1	1	–	All the sluices are in bad condition
About 3–4	–		Nil	2	–	2	2	1	–	1	All sluices are fully damaged. Surplus weir 50% damaged. Mud wall constructed by farmers to store more water.
About 5	–		About 15–20 acres	4	3	1	4	1	–	1	Entire s.weir is damaged in many places i.e without any concrete structure. 75% damaged
Fully silted up	–		About 50 acres for house sites since 1980	3	3	–	–	2	2	–	–
More than 50 %	–		About 20 acres by 3 persons since 1975	4	–	4	4	1	1	–	All sluices are in bad condition–water leakage. Stones/mud are used to control. water – no shutters.
–	About 4'		Nil	3	2	1	3	1	1	–	Entire land of surplus weir is encroached for cultivation by well farmers since 1970.
More than 60 %	–		About 5 acres for house sites 15 persons	4	1	3	4	2	2	–	Mettu madagu is badly designed by the PWD – affects the flow greatly. Water is not flowing freely from this sluice.
About 8	–		About 5–10 acres	4	3	1	4	1	–	1	Palla madagu is fully damaged causing water problem. Entire surplus weir is broken without any concrete structure.
About 6	–		Nil	1	1	–	1	2	2	–	*Salaram* is found below surplus weir for irrigation.
About 6	–		15–20 acres by the villagers since 1990	2	2	–	2	1	1	–	Mud/stones are used for closing sluices.
–	About 3'		About 3 acres for the past 10 years	4	3	1	4	2	2	–	Palla madagu is 50 % damaged, causing water problem.
No	About 20 %		About 30 acres for the past 10 years	3	2	1	3	3	–	3	Nadu madagu is fully damaged causing water leakage. 50% of the surplus weir damaged
More than 50 %	No		About 30 acres by 30 persons past 10 yrs	3	1	2	3	3	1	2	Required some minor repairs.
5	No		About 10 acres by villagers since 1990	2	–	2	2	3	3	–	–
More than 50 %	No		About 12 acres by villagers since 1980	1	–	1	1	1	1	–	Fully damaged causing water problem.

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Table A4.4: Conditions of Physical Structures in the Palar Non-system Tanks, 1995

Tank Sl No	Inlet channel			Tank *bund*	
	Good	Encroached feet/km	Silted	Good	Breached
1	2	3	4	5	6
Head-reach tanks					
1	No	Encroached by same villgers since 1985 for sugarcane cultivation	3'	No	100-200 m breached in two pla between palla madagu and surpl
2	No	Width :- Original: 21' Current:10'	Depth:- Original:6' Current:3'	No	100-200' breached in three plac
3	No	Width :- Original: 20' Current:10'	Depth:- Original:7' Current:3'	No	About 5-6' breached in 4 places
4	No	Width :- Original: 15' Current:10'	Depth:- Original:12'Current:6'	No	About 1 km is very weak
5	No	No	Yes	No	About 300' breached in 1 place
6	No	No	No	No	Breached in 20-25 places for about 5'-7' distance
7	No	Width :- Original: 30' Current:20'	Depth:- Original: 6' Current:6'	No	About 1.5 km is damaged due to collection of firewood
Middle-reach tanks					
8	No	No	No	No	Very weak
9	No	Width :- Original:20' Current:5'	Depth:- Original:3' Current:1.5'	No	Very weak in three places
10	No	No	Depth:- Original:10'Current:4'	No	Breached in five places due to arrack sales
11	No	Kasam is fully encroached since 1980	Depth:- Original: 20'Current:10'	No	Breached in five places
12	No	Width :- Original: 30' Current:5'	Depth:- Original: 6' Current:4'	No	Breached in five places for about
13	No	No	About 25%	No	Breached in one place
14	No	Encroached for house construction	about 3 km silted up	No	Breached in three places
15	No	About 0.2 km by Kalakattur villagers since 1980	Yes	No	Breached in 10 places
Tail-reach tanks					
16	No	No	About 3 furlong silted up	No	Breached in centre
17	No	No	About 3 km silted up	No	Breached in three places
18	No	Yes	No	Yes	No
19	No	Width :- original: 15' Current:10'	About 3' silted	No	Breached in five places for past 5
20	No	No	No	No	Very weak in one place
21	No	Yes	No	No	*Bund* is weak in many places
22	No	Width :- Original: 10' Current:3'	Yes	No	Entire *bund* is weak

Note: – Indicates nil.

	Tankbed			Sluices and control structures				Surplus weir			Remarks
al pth et)	Siltation (feet) Heavy	Not much	Encroached	Total No	Good	Damaged	No shutters	Total No	Good	Weak	
7	8	9	10	11	12	13	14	15	16	17	18
	About five	_	About 50 acres (past 10 years)	3	1	2	3	2	2	–	Mud and stones are used for closing the sluices to stop the water.
9	About four	–	About 25 acres (past 15 years)	5	4	1	5	1	–	1	Palla madagu fully damaged
2	About five	_	About 70 acres (past five years) for house sites	5	2	3	5	2	–	2	Surplus weirs are fully damaged
6	About six	_	About three acres (past 30 years)	4	3	1	4	1	1	–	*Palla madagu* is fully damaged
5	Five	–	–	4	3	1	4	1	1	–	Mud and stones are used to control water
3	Six	–	About 10 acres (past 15 years)	3	–	3	3	2	2	–	*Sevuttu madagu* is fully damaged since the past six years. No water supply sluice due to this effect from this
9	four	–	About 50 acres for sugarcane since 1985.	2	–	2	2	2	2	–	*Mettu madagu* is fully damaged.
?	About 50 %	–	No	1	–	1	1	1	1	–	Water leakage
4	About six	–	About 25 acres	3	–	3	3	1	–	1	*Palla madagu* is fully damaged.
8	More than 50 %	–	About 20 acres since 1990	5	4	1	5	3	3	–	*Palla madagu* is fully damaged since 1990
?	three	About eight	acres by 10 persons	3	–	3	3	1	1	–	All the sluices are very bad
0	About 70 %	–	About 25 acres for the past three years	6	–	6	3	3	1	2	Two surplus weirs are fully damaged
8	Six	–	–	3	–	3	3	1	–	1	All the sluices are in bad condition. surplus weir is broken in many places
2	About five	–	Yes	2	2	–	–	1	1	–	–
-	Three	–	Two	1	1	2	1	1	–		*Mettu madagu* is not used for the past 20 years
1	–	Three	Encroached by textile industry	2	–	2	2	1	1	–	Mud and stones are used to control water
1	–	Yes	Yes	2	–	2	2	1	1	–	–
7	–	Yes	No	3	–	3	3	1	–	1	Surplus weir is damaged
1	Yes	–	About 10 acres (past 10 years)	4	1	3	4	1	1	–	–
2	Yes	–	About four acres by two persons	1	–	1	1	1	–	1	Surplus weir is broken in many places
3	No	No	Yes	2	1	1	2	–	–	–	No surplus weir and it caused for weakening of the tank *bund*
0	Yes	–	–	5	–	5	5	1	1	–	–

urce: Interviews conducted with experienced farmers and *thalaiyaries*, 1995

Table A4.5: Water Supply Conditions in the Palar System Tanks, 1994-95

Tank Sl No	Problem with upstream *ayacutdars*/villages in getting water supply	Actual fillings			Duration (Months/days)			Date of release (months)			Increase/ decrease in the ayacut (hectares)	Difference in water supply condition between head and tail-reaches
		1994-1995	93-94	92-93	1994-1995	93-94	92-93	1994-1995	93-94	92-93		
1	2	3	4	5	6	7	8	9	10	11	12	13
Head-reach tanks												
1	Karapattu villagers obstruct water supply by constructing a new concrete wall (3')across the river to get more water.	–	–	1	40*	20*	2	I	I	I	+10	If the number of filling is only one there is 15-20 days difference in WSC between head and tail-reaches. About 90 acres are affected.
2	Thorapadi *ayacutdars* every year obstruct the flow in the river by constructing mud *kondam* across it since 1983.Also they divert water from the supply channel by cutting the *bund*.	1	1	1	3	4	4	I	A	A	+50	Difference exists in water supply condition between reaches for About 5-10 waterings. About 50-60 are affected by water scarcity.
3	There are about 80 *kondams* illegally constructed across the supply channel for direct irrigation. *Kavalai* was also used for lifting water and it is more from the past past 10 years.	1	1	1	3	5	5	P	P	P	–	Difference is there between head and tail reaches in WSC if the number of filling is only one. About 30-40 acres of tail-end lands are affected during such scarcity times. About 5-6 waterings are inadequate for the tail-enders at the time of the *panicle* and maturity stage of the crop growth period.
4	Illegal diversion of water by the upstream ayacutdars of Theethanda-pattu village in the inlet channel A court case was filed by the *ayacutdars* about seven years ago.	1	1	–	3	3	2	P	P	I	+4	During one season there is no difference in WSC between the reaches. All farmers harvested one crop without any problem.
Middle-reach tanks												
5	Ekanapuram,Thandalam and Parandur village farmers obstruct water supply by cross *bunding* the Kamm-bakkal channel. Since it is a tail-end tank, they do not get adequate water supply due to this effect	–	–	–	10-15*	3	7*	–	M	–	–	No difference in WSC due to the implementation of the *orumadai paiychal*. Available water is shared equally by adopting *murai* system.
6	The *ayacutdars* of Singlipadi obstruct water supply by cross *bunding* the supply channel using mud and stones causing water problem.	1	1	1	3	3	3	M	M	M	–	There is difference in the WSC between reaches for about half to one month. About 150 acres of tail-end were affected.
7	The Natteri *ayacutdars* usually divert water supply very often from the supply channel and affects the supply to the tank to a great extent.The encroachment of the supply channel also affects the supply.	–	–	–	4	4	1	K	K	M	–	When the water level in the tank decreased to one month, all are facing water problem. At that time murai is adopted in order to use the available water efficiently It never surplused after 1966 due to the tail-end tank.
8	The Damal *ayacutdars* very often cross *bunding* the supply channel by using mud and stones to get more water sully.During the year 1977, the entire Kammbakkal channel was obstructed by the above mentioned *ayacutdars* which paved a way for frequent conflicts	–	–	–	2	2	1	K	K	M	– 0.81	There is always half to one month difference in WSC between the reaches as the tank has no surplus since 1978. The available water was inadequate for all. Death storage water was also used by the head reach farmers for about one week by using human lifting.
9	The supply channel is encroached by the upstream farmers of this same village from the past 15-20 years which affects the tank water supply to a great extent.It depends mainly upon rain water only and never surplused after 1965 due to the tail-end tank.	–	–	–	1	1	20*	I	I	I	– 161.9	Due to the tail-end tank it never surplused after 1965. The available water was inadequate and used by the head-reach farmers for about 10-20 days only.
10	Water from the Kambakkal channel is illegally used by Molasur *ayacutdars* by errecting mud *kondams* across the channel for directirrigation & percolation pond. Being tail-end the problem becomes worse since 1975. It never surplused after 1986.	–	–	–	2.5	2.5	1	M	M	–	–	About one month water supply was available to tail enders during *Navarai* season. However 1st season *Samba* does not have difference in water supply conditions due to the adoption of broadcasting method.
11	The Palar supply is stopped in 1957 due to accumulation of silt & encroachment by the upstream villagers for house construction.	–	–	–	2	2	2	M	M	M	–	The duration of supply was meagre and hence all are facing water problem. But the worst sufferers are the tail-enders.Generally about 15 days difference in WSC between head and tail-reaches.

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Tank Sl No	Problem with upstream *ayacutdars*/villages in getting water supply	Actual fillings			Duration (months/days)			Date of release (months)			Increase/ decrease in the *ayacut* (Hcts)	Difference in water supply condition between head & tail-reaches
		1994-1995	93-94	92-93	1994-1995	93-94	92-93	1994-1995	93-94	92-93		
1	2	3	4	5	6	7	8	9	10	11	12	13
Tail-reach tanks												
12	Illegal tapping of water by the Kilkodungalur farmers since 1975 affects the flow to a great extent.During night time, those are going for catching fish used to open the shutters in the supply channel to drain water, which led to inadequate water supply.	1	1	–	4	4	10*	K	K	–	+8.1	Before 20 years they raised two crops. But in the recent years they could raise only one crop become because the tank's capacity is reduced. There is not much difference in WSC between the reaches during 93-94 due to which the tank got surplus water supply. But in 92-93 the the tank water was not released due to inadequate water supply.
13	The water supply from the supply channel is diverted for direct irrigation by the same village farmers since 1990 which led to inadequate water supply to the tank.	1	1	1	3	3	3	I	I	K	–	During 1992-93 and 1994-95 about 20-30 acres of the tail-end were affected due to the shortage of the water supply at the panicle and maturity stages of the crop growth period.
14	–	1	1	–	6	6	2	P	P	P	+12.1	During I season there is no difference in WSC between the reaches. But in the II season (*navarai*) there is about 30-40 days difference in WSC between head and tail-reaches. About 30-40 acres of non-well farmers were affected. During 1992-93 all farmers were affected.
15	The water from the supply channel is diverted for direct irrigation by constructing two mud *kondams* across the channel by Adikesavan Naidu of Vallam village since1988. About 70 acres are benefited from this source.	1	–	–	6	1	10-20*	P	P	–	+28.3	During 1994-95 in the I season there is no difference in WSC between the reaches.But in the II season there is about 20 days difference in WSC. About 70 acres of tail-end have been affected. During 1993-94 all farmers faced water problem due to lack of tank water. About 10 acres only cultivated by the head reach farmers.
16	The supply channel is encroached by the upstream farmers of Thandalam, Elankadu and Avanavadi for the past 20 years which affects the flow to a great extent. Due to this the rainwater does not flow to the tank properly.	1	–	–	7	4	10-15*	A	P	–	–	During 94-95 two crops were raised by all *ayacutdars*. But in the year 93-94 the tail enders faced water problem for about 10 days only. During 92-93 water was not released from the tank due to inadequate water supply.
17	The surplus weir of the upstream tank, namely Soraputhur eri is raised illegally for about 2" which leads to shortage of water supply and frequent conflicts between them since 1960. A court case was also filed and it favoured our sampled village. In order to avoid flood entering into the village Natteri and Soraputhur villagers diverted water from the supply channels to fields to drain water. Because of the reason the available water does not flow to the tank freely	1	1	–	6	6	1	A	Ani	–	–	Difference exists between reaches for about 15-20 days during *navarai* season. About 15-20 acres were affected during 93-94 due to shortage of water at the panicle and maturity stage of of the crop growth period. But during 1992-93 there was no crop raised by the *ayacutdars*.
18	Since 1988, water does not flow to this tank due to the encroachment of the supply channel by the upstream *ayacutdars* of Koothapattu village, causing water problem.	–	1	–	1.5	5	2	–	I	I	–	During 94-95 water was not released from the tank due to shortage and also to get seepage water for wells. During 93-94 difference exists between both the reaches for about one month only during *navarai* season. Only well owners raised 150 acres of *navarai* crop. During 92-93 well owners only raised the first crop.

Note: – Indicates nil;
NA = Not available;
WSC = Water supply condition;
I = *Ippasi;*
M = *Markali;*
K = *Karthikai;*
P = *Purattasi;*
A = *Aavani;*
Figures marked * are in days.

Source: Interviews conducted with experienced farmers and *thalaiyaries*, 1995

Table A4.6: Water Supply Conditions in the Palar Non-system Tanks, 1994-95

Tank Sl No	Problem with upstream *ayacutdars*/villages in getting water supply	Actual fillings			Duration (months/days)			Date of release (months)			Increase/ decrease in the *ayacut* (hectares)	Difference in water supply condition between head & tail-reaches
		1994-1995	93-94	92-93	1994-1995	93-94	92-93	1994-1995	93-94	92-93		
1	2	3	4	5	6	7	8	9	10	11	12	13
Head-reach tanks												
1	–	1	–	–	3	1	2	P	A	P	+ 20.24	If the number of fillings is only one there is some difference in WSC of about 30 days between the reaches. About 100-150 acres are affected. The worst sufferers are the Mettu Madagu *ayacutdars*.
2	Often Natteri *ayacutdars* divert water supply illegally for direct irrigation which affects the inflow to a great extent.	–	–	–	2	1.5	3	I	I	P	+ 22.3	Difference exists in WSC between reaches for about 10-30 days when the number of filling is only one. About 60-90 acres are affected.
3	Illegal diversion of water by the upstream *ayacutdars* of ladavaram obstructs the supply in the inlet channel. Disputes arises very often and a court case has been filed.	–	–	–	40*	2	5-10*	P	P	–	+ 16.2	Difference exists in water supply condition between both reaches of about 25-30 days. But water was used only by the Pallamadagu *ayacutdars* who owned wells during 1993-95 as to the tank had no surplused since 1986.
4	–	–	–	–	1.5	1.5	3	K	K	K	+ 48.6 Punjai	There is always 30-40 days difference between the reaches as the tanks do not get surplus water water since 1983.The water was used only by the Pallamadagu farmers
5	–	1	–	1	6	4	6	A	A	A	– 16.2	Problem exists between the head and tail reaches during scarcity period.About 20-30 days difference in WSC between reaches.Tail enders of Seeram-palayam do not get water supply due to lack of field channels.
6	–	–	–	–	2	2.5	10*	K	K	–	+ 2	Problem exists between head and tail-reaches during scarcity period. About 15-20 days difference in WSC between reaches. Available water was used only by the head reach farmers of Pallamadagu during 1993-95.
7	Upstream *ayacutdars* of Melvannianur obstruct the inlet channel supply by using cement pipe. The problem was reported to the collector and the pipe removed. Still the problem continues as more water is drawn to the upstream tank.	–	–	–	3	3	2	P	P	P	+ 121.5 Punjai	About 120 acres of tail-reach are affected due to scarcity condition for about one month.
Middle-reach tanks												
8	Upstream farmers of Orathur used to obstruct the water supply by cross *bunding* the inlet channel for a long time. The villagers petitioned to the collector who after on inspection passed an order in 1987 upholding the rights of Arampakkam *ayacutdars* for uninterrupted supply. But still the problem continues.	1	1	1	4	5	4	A	A	A	–	There are problems between head and tail-reaches in WSC.Also the Mettu Madagu lands, about 150 acres, had severe water problems for about 5 years. Hence lands under this sluice are being sold to real estate owners.
9	–	1	–	1	3	2	3	P	K	K	+ 20.2	Difference exists between head and tail-reaches for about 20 days in WSC. About 50-60 acres of tail-end, particularly Mettu Madagu was affected due to inadequate water supply.
10	–	1	1	1	5	5	5	K	P	P	– 101.2	There is no *sambha* crop raised due to pest attacks & labour shortage. There is no difference in WSC between the reaches during *navarai* season. But after *navarai* all are facing 1 month water problem.
11	Since 1980 the Kasam water is stopped due to the encroachment of the upstream villagers of Viyavoor.	–	–	–	2	2	2	M	K	M	–	Difference exists between head and tail-reaches for about one month in water supply condition. The crop is affected in all the reaches as the tank had no surplus since 1986.
12	–	1	1	–	3	3	15*	M	K	–	–	Tail-enders have water supply problem for e.g, in 1994-95 about 100 acres, 1993-94 about 150 acres and 92-93 entire *ayacuts* were affected.

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Continued A4.6

Tank No Sl	Problem with upstream *ayacutdars*/villages in getting water supply	Actual fillings			Duration (months/days)			Date of release (months)			Increase/ decrease in the *ayacut* (hectares)	Difference in water supply condition between head & tail-reaches
		1994-1995	93-94	92-93	1994-1995	93-94	92-93	1994-1995	93-94	92-93		
1	2	3	4	5	6	7	8	9	10	11	12	13
13	–	1	1	1	4	4	4	P	A	P	+ 4	During the first season there is no water problem. But during the second season all are facing water problem. But the tail-enders are the worst sufferers. About 15-20 days difference in water supply condition between both the reaches.
14	– Irrigation by the same village farmers since 1990 which led to inadequate water supply to the tank.	1	1	1	1.5	1.5	1	K	K	M	–	–
15	Kalakattur *ayacutdars* block the inlet channel in order to divert water for direct irrigation since 1980. The supply channel is also encroached on by them and it affects the flow to a great extent.	–	–	–	2	2	1	T	T	Masi	–	During the first season spring channel water was used by the *ayacutdars*. Tank water was used only during the *navarai* season. Difference exists for both reaches and it is solved by adopting the *murai* system.
Tail-reach tanks												
16	–	–	1	–	3	5	–	P	P	–	–	When water level in the tank decreased to one month supply both of them were facing water problem. But the worst sufferers are the tail enders. About 20-30 days difference in WSC between them.
17	There used to be a problem with upstream *ayacutdars* (Kendracheri) who though not entitled for water supply have diverted water by cross-bunding the inlet channel. Since it is situated at a distance of 3 kms, keeping a watch on upstream tank difficult. This has resulted inter village dispute. The collector intervened and prevented further trouble. But the problem still continues.	1	1	1	6	6	2	P	P	P	–	No specific problem for the tail-enders
18	–	1	1	1	9	6	4	Aadi	P	P	–	No specific problem for the tail-enders
19	The supply channel is encro-ached by the upstream *ayacutdars* of Melavalam and Thottanaval, which affects the flow to a great extent.	1	–	–	4	1	1	I	T	T	–	Due to the adoption of *oru madai paichal* during the water scarcity period there is no difference in WSC between the reaches. Available water is shared by adopting the *murai* system.
20	–	1	1	1	2.5	2.5	2.5	K	I	K	–	Difference always exists between both reaches for about 15-30 days in water supply condition during all the years as the water-holding capacity of the tank is reduced from 4-2 months. The available water is used only by the head-reach farmers.
21	The upstream village *ayacutdars* of Karunkuzhi obstruct the inlet channel for direct irrigation. Also, water is diverted to other tanks on the way by obstructing the supply channel.	1	1	1	3	3	3	A	A	P	–	The available water is equitably shared by adopting the *murai* system.
22	–	1.5	1	1	4	3	3	I	I	I	–	Tail-end has water problem during *panicle* and maturity stage of the crop growth period, when there is scarcity. The problem is serious as the main channels were encroached and not desilted properly for a long time.

Note: – Indicates nil;
NA = Not available;
WSC = Water supply condition;
I = *Ippasi*. M = *Markali*;
K = *Karthikai*;
P = *Purattasi*;
A = *Aavani*;
T = *Thai*'
Figures marked * are in days.

Source: Interviews conducted with experienced farmers and *thalaiyaries*, 1995.

Table A4.7: Structure of Irrigation Organisation in the Palar system Tanks, 1994-95

Tank Sl No	Name of the functionary Kavaimaniyam/Nattamai/ Periathanakkarar	Caste	Number	Land holdings (acres)	Hereditary/ elected	period (year)	Single/ Multi-caste	Whether confined to tank-related matters/ village affairs	Remuneration
1	2	3	4	5	6	7	8	9	10
Head-reach tanks									
1	–	–	–	–	–	–	–	–	–
2	*Nattamai*	Gounder 1 Konar 1 Naidu 1 Oddar 1 SC 1	1 1 1 1 1	– 2 20 3 –	Elected (Elected every year from different castes since 1991. Earlier only one person was there. Due to awareness among people, selection is made from all castes)	1	MC	Both affairs	–
3	–	–		–	–	–	–	–	–
4	–	–		–	–	–	–	–	–
Middle-reach tanks									
5	*Nattamai*	Gounder	2	3+5	Hereditary	–	S	Both affairs	–
6	*Perunthanakkarar*	Gounder	2	0.25+2	Elected	Once in 3 years	S	Mostly involved in village affairs. Involvement in tank-related matters is very limited	–
7	*Kavaimaniyam*	Naicker	1	0.60	Hereditary (5th *thalaimurai*)	–	S	Both affairs	4 kgs of paddy/acre/ season
8	*Nattamai*	Gounder	12	5–20	Elected (Before 5 years it was hereditary)	1	S	Mostly involved in Village affairs. Involvement in tank related matters is very limited	–
9	– (Before 6–7 years *kavai–maniyam* was there)	–		–	–	–	–	–	–
10	*Perunthanakkarar*	Naicker 4 SC 1		2–10 –	Elected (Some 20 years before, hereditary nattamai was there. But now periathanakkars are selected by street)	1	MC	Mostly involved in village affairs. Involvement in tank related matters is very limited	–
11	– (Before 25 years kavai-maniyam was there)	–		–	–	–	–	–	–
Tail-reach tanks									
12	–	–		–	–	–	–	–	–
13	– (Before 20 years *kavai-maniyam* was there)	–		–	–	–	–	–	–
14	– (Earlier *nattamai* was there)	–		–	–	–	–	–	–
15	*Nattamaies*	Gounder 6 Chettiar 1		2 4	Elected	1	MC	Both affairs	–
16	–	–		–	–	–	–	–	–
17	– (Before 30 years *Nattamai* was there)	–		–	–	–	–	–	–
18	*Nattamai*	Gounder	1	3	Hereditary	–	S	Village affairs only. 10-15 years ago they were involved in tank-related matters.	–

Note: SC = Scheduled Caste; LA = Less active; IA = Inactive; – indicates nil; S = Single caste; MC = Multi-caste,; KVM = Kavaimaniyam.
Source: Interviews conducted with experienced farmers and *thalaiyaries*, 1995.

Table A4.8: Structure of Irrigation Organisation in the Palar Non-system Tanks, 1994-95

Tank Sl No	Name of the functionary *Kavaimaniyam/Nattamai/ Periathanakkarar*	Caste	Number	Land holdings (acres)	Hereditary/ elected	Period (year)	Single/ multi-caste	Whether confined to tank-related matters/ Village affairs	Remuneration
1	2	3	4	5	6	7	8	9	10
Head-reach tanks									
1	–	–	–	–	–	–	–	–	–
2	–	–	–	–	–	–	–	–	–
3	– (Before 1975 *nattamai* was there)	–	–	–	–	–	–	–	–
4	–	–	–	–	–	–	–	–	–
5	– (As the tank is a new one, a major portion of *ayacut* does not get water Organisation and collective efforts by farmers have not developed)	–	–	–	–	–	–	–	–
6	– (20 years ago, *muraikkarar/ periathanakkarar* was there (*muthapillai*)	–	–	–	–	–	–	–	–
7	– (20 years ago, KVM was there (Ramanatha Udayar)	–	–	–	–	–	–	–	–
Middle-reach tanks									
8	*Periathanakkarar*	Gounder	2	10-20	Hereditary	–	S	Mostly involved in the village affairs	–
9	*Nattamai*	Gounder	1	10	Hereditary	–	S	Both affairs	–
10	– (Earlier *nattamai* was there)	–	–	–	–	–	–	–	–
11	–	–	–	–	–	–	–	–	–
12	– (Ex-president takes initiatives for organising meetings)	–	–	–	–	–	–	–	–
13	*Nattamaies*	Naidu Chettiar Pillai SC	1 1 1 1	15 5 4 5	Hereditary	–	MC	Both affairs	–
14	*Panchayatdars*	Naidu Yadavar Mudaliar	3 2 1	NA NA NA	Hereditary	–	MC	Both affairs	–
15	*Kavaimaniyam*	Naicker	1	1	Hereditary (Selected out of 40 share-holders among the *ayacutdars*, depending upon the performance of the KVM. No specific period for this appointment. If the work is found to be unsatisfactory he will not be elected again. The present KVM is working since 1991.	–	S	Tank affairs only	Rs 15/ month for 4 months only
Tail-reach tanks									
16	– (Before 1990 *Nattamai* was there)	–	–	–	–	–	–	–	–
17	*Nattamaies*	Yadavar Gounder V Karar SC	2 2 1 3	5 2 0 2	Elected	–	MC	Both affairs	–

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Tank Sl No	Name of the functionary *Kavaimaniyam/Nattamai/ Periathanakkarar*	Caste	Number	Land holdings (acres)	Hereditary/ elected	Period (year)	Single/ multi-caste	Whether confined to tank-related matters/ Village affairs	Remuneration
1	2	3	4	5	6	7	8	9	10
18	Nattamaies	Gounder	3	3-10	Hereditary	–	S	Both affairs (They look after all village affairs. As regards irrigation, order for release of water and closing of sluices is given by *nattamaies* who decide jointly)	–
19	*Periathanakkarar*	Chettiar Mudaliar Yadavar	1 1 1	5 5 4	Elected (There is no formal method in the selection. Whenever they want they change them)	–	MC	Both affairs (It is a volundary service done by the *periathanakkarar*. They are taking the responsibility for organising *ayacutdars* to take decisions regarding irrigation and other village matters)	–
20	– (Before 1980 irrigation functionaries were there)	–	–	–	–	–	–	–	–
21	*Nattamaies*	Gounder	3	5	Hereditary	–	S	Both affairs	–
22	–	–	–	–	–	–	–	–	–

Note: SC = Scheduled Caste;
LA = Less active;
IA = Inactive;
– indicates Nil;
S = Single caste;
MC = Multi-caste;
KVM = *Kavaimaniyam;*
V Karar = *Vettaikarar;*
NA = Not available.

Source: Interviews conducted with experienced farmers and *thalaiyaries*, 1995.

Table A4.9: Structure of Irrigation Workers in the Palar System Tanks, 1994-95

Tank Sl No	Name of the functionary *Thotti/kammukutti*	Caste	No of persons	Land holdings (acres)	Hereditary/elected	period (year)	Whether confined to tank related matters/village affairs	Remuneration/acre/ season/person
1	2	3	4	5	6	7	8	9
Head-reach tanks								
1	*Thotti*	SC	1	0	Hereditary (Selection is made by rotation among 4 families)	1	Both affairs: 1) Opening and closing of sluices. 2) Drum beating 3) Removing dead cattle 4) Passing death information to others.	One bundle with straw which gives about 1.5 *marakkal*
2	*Thotti*	SC	1	0	Hereditary (Selection is made by rotation among 5 families)	1	Both affairs: a) Watching the flow of water in the inlet channel along with others. It is the only work done by him at the tank b) He also does drum beating.	2 bundles with straw which give about 4 *marakkal*
3	Nil (For the past 3 years there are no irrigation workers in this village. Earlier one *thotti* was there to take care of the tank and village affairs. Due to prestige issue and poor wages the person stopped working. The Ambedkar movement is instrumental in stopping such slave labour, according to respondents.	–	–	–	–	–	–	–
4	*Thotti*	SC	2	0	Hereditary (Selection is made by rotation among 6 families)	1	Tank only Opening and closing of sluices only and not involved in watering.	One bundle with straw which gives about 2 *marakkal*
Middle-reach tanks								
5	*Kammukutti*	SC	1	0	Hereditary (Selection is made by rotation among 5 families)	1	Tank only a) Opening and closing sluices b) Watering the field c) Taking the farmers to field channels for desilting work etc.	Threee bundles with straw which give about 3 *marakkal*
6	*Kammukutti*	SC	2	0	Hereditary (Each year comes in rotation among 20 families)	1	Tank only: a) Opening and closing of sluices b) Watering the field.	1.5 bundles with straw which give about 2-3 *marakkal*
7	*Kammukutti*	SC	2	0.6	Hereditary (Each year comes in rotation among 16 families)	1	a) Opening and closing of sluices b) Watching the supply channel, *bund*, water and crop c) Measurement is made by the *kammukutties* at the time of desilting.	3/4 marakkals of paddy. No bundle is given. Fine is collected if the work is not satisfactory
8	*Kammukutti*	SC	2	0	Hereditary (Each year comes in rotation between 2 families)	1	Tank only: a) Opening and closing of sluices, watering. b) Watching water level in the tank during the rainy season to take precautionary measures against flood and d) Drum beating at the time of maintenance.	2 bundles with straw which give about 4 *marakkal*

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Tank Sl No	Name of the functionary *Thotti/kammukutti*	Caste	No of persons	Land holdings (acres)	Hereditary/elected	period (year)	Whether confined to tank related matters/village affairs	Remuneration/acre/ season/person
1	2	3	4	5	6	7	8	9
9	Nil Since 1988 there was no irrigation worker due to lack of co-operation among farmers and active involvement in the non-farm activity like silk weaving	–	–	–	–	–	–	–
10	*Kammukutti*	SC	2	0	Hereditary (Each year comes in rotation among 10 families)	1	Tank only a) Opening and closing of sluices, b) Watering the field	2 bundles with straw which gives about 3 *marakkal*
11	*Kammukutti*	SC	2	0	Hereditary (Each year comes in rotation among 4 families)	1	Tank only Opening and closing of sluices only and not involved in watering of *maniyam* land was given. But now no *maniyam* land.	One bundle/ 2 *marakkal* of paddy. Earlier 30 cents
Tail-reach tanks								
12	Nil (Before 20 years 5 *kammukutties* were appointed. Due to conflicts between Gounders and SCs they were stopped).	–	–	–	–	–	–	–
13	Nil	–	–	–	–	–	–	–
14	Nil	–	–	–	–	–	–	–
15	*Thotti* (The other village *ayacutdars* of Nanjambadi are also using the same *thotties*)	SC	2	0	Hereditary (Each year comes in rotation among 10 families)	1	Tank only a) Opening and closing of sluices, b) uprooting the seedlings etc.	2 bundles with straw which give about 5 *marakkal*
16	Nil (As the *thotties'* works were unsatisfactory, a majority of farmers refused to pay wages to them. So they do not come for work since 1965	–	–	–	–	–	–	–
17	Nil (A year ago 4 *thotties* took the responsibilities of both affairs. Due to poor wages and prestige issue, they stopped working. In recent years adoption of S.cane cultivation and reduction in the wage rates led to failure of the traditional system. The Ambedkar movement is instrumental in stopping such slave labour according to respondents)	–	–	–	–	–	–	–
18	Nil (Ten years ago when *Nattanmai* was present there were 4 *Thotties* in this village. They were selected on rotation basis among 500 families. The adoption of S.cane cultivation and reduction in wage rate led to the failure of traditional system)	–	–	–	–	–	–	–

Note: SC = Scheduled caste, LA = Less active, IA = Inactive, – Indicates nil.
Source: Interviews conducted with experienced Farmers and *thalaiyaries*, 1995.

Table A4.10: Structure of Irrigation Workers in the Palar Non-system Tanks, 1994-95

Tank Sl No	Name of the functionary *Thotti/kammukutti*	Caste	No of persons	Land holdings (acres)	Hereditary/elected	Period (year)	Whether confined to tank related matters/village affairs	Remuneration/acre/ season/person
1	2	3	4	5	6	7	8	9
Head-reach tanks								
1	Nil (Five years ago four Thotties were selected on rotation basis among 100 families. In the recent years majority of the farmers failed to give wages/*aries* to the *kammukutties* since 1990 especially the S.cane growers)	–	–		–	–	–	–
2	Thotties	SC	2	0	Hereditary (Selection is made on rotation among 200 families)	1	Both affairs: a) Opening and closing of sluices. b) Village affairs.	Two bundles of paddy/acre with straw which give about 5 *marakkals.*
3	Nil (Fifteen years ago, during the Brahmins period one *Kammukutti* was appointed from the Gounder caste for sluice operations only. At present nobody is appointed. The people themselves involved in the above said activities)	–	–		–	–	–	–
4	*Kammukutti*	SC	1	0	Hereditary (Each year comes in rotation among 4 families)	1	Tank only: a) Opening/closing of sluices. (b) Watching the supply channel *bund*, water and crop c) He also does other jobs like uprooting the seedlings, etc.	One bundle/acre. 2 *marakkals.*
5	Nil (As the tank is new and a major portion of *ayacut* does not get irrigation, organisation and collective efforts by farmers have not developed)	–	–		–	–	–	–
6	*Thotties*	SC	2	0	Hereditary (Each year comes in rotation between 2 families)	1	Both affairs: a) Opening and closing of sluices b) Village affairs.	Two bundles of paddy/acre with straw which gives about 5 *marakkals*
7	Nil (Twenty years ago *Thotties* there were three as irrigation workers there. Development of S. cane cultivation due to increase in number of wells has also contributed for decline in the Institutional arrangements As S. cane become a major crop the *thotties* lost to interest as they could not get more paddy)	–	–	–	–	–	–	–
Middle-reach tanks								
8	*Kammukutti*	SC	1	0	Hereditary (Each year comes in rotation among 15 families)	1	Tank only: a) Opening and closing of sluices, b) Watering and watching the field, etc.	One bundle/acre. 2 *marakkals.*
9	*Kammukutties*	SC	2	0	Hereditary (Each year comes in rotation among 20 families)	1	Both affairs: a) Opening and closing of sluices. b) Watering and watching the field, c) Desilting the branch channels d) Other works like drum beating and removing dead cattle.	One *marakkal*/ acre.

Continued

Continued A4.10

Tank Sl No	Name of the functionary *Thotti/kammukutti*	Caste	No of persons	Land holdings (acres)	Hereditary/elected	period (year)	Whether confined to tank related matters/village affairs	Remuneration/acre/ season/person
1	2	3	4	5	6	7	8	9
10	*Kammukutti*	SC	1	0	Hereditary (Each year comes in rotation among 3 families)	1	Tank only: a) Opening and closing of sluices, b) Watering and watching the fields, etc.	One bundle/acre. 2 *marakkals.*
11	Nil (Six years ago, *thotties* took the responsibilities of both village and tank affairs. Due to poor wages and caste discrimination they stopped working. The Ambedkar movement is instrumental in stopping such slave labour, according to respondents)	–	–	–	–	–	–	–
12	*Vettiyan*	SC	3	0	Hereditary (Each year comes in rotation among 100 families)	1	Tank only: a) Opening and closing of sluices, b) Watering and watching the fields, etc	13 aries/acre. 1 *marakkal.*
13	*Kammukutties*	SC	2	0	Hereditary (Each year comes in rotation among 8 families)	1	a) Opening and closing of sluices	4 marakkals/acre.
14	*Kammukutties*	SC	2	0	Hereditary (Each year comes in rotation among SC families)	1	a) Opening and closing of sluices, b) Watering and watching the fields, etc.	4 *marakkals*/acre.
15	*Kammukutties*	SC	2	0	Hereditary (Each year comes in rotation among SC families)	1	Tank only: a) Opening and closing of sluices, b) Watching the tank and water c) Watering the field.	4 bundles/acre. 5 *marakkals.*
Tail-reach tanks								
16	Nil (Before 1990,there were two *kammukutties* and got one bundle of paddy/acre/season. But in the recent years they demanded 2 *marakkals* of paddy along with one bundle as wage due to heavy work. The specified works were watering, uprooting and threshing etc. But the farmers refused to give wages. Because of this, they stopped to render their services)	–	–	–	–	–	–	–
17	*Kammukutti*	SC	1	0	Hereditary (Each year comes in rotation among 30 families)	1	Tank only: a) Opening and closing of sluices and b) Watering, etc.	2 *marakkals*/acre
18	*Kammukutties*	SC	2	0	Hereditary (Each year comes in rotation among 27 families)	1	Tank only: a) Opening and closing of sluices and b) Watering is done	one marakkal/acre
19	*Kammukutties*	SC	2	0	Hereditary (Each year comes in rotation among SC families)	1	Tank only a) Opening and closing of sluices and b) Watering is done	1 bundle/acre
20	Nil (Before 25 years, irrigation workers were found in this village)	–	–	–	–	–	–	–
21	*Kammukutties*	SC	2	0	Hereditary (Each year comes in rotation among SC families)	1	Tank only: a) Opening and closing of sluices, b) Watering and watching the flow in the supply channel to ensure that the supply is not obstructed by upstream villagers etc.	1 bundle/acre 1-2 *marakkals*
22	*Kammukutties*	SC	2	0	Hereditary (Each year comes in rotation among SC families)	1	Tank only: a) Opening and closing of sluices only	1 bundle/acre. 1 *marakkal*

Note: * *Kammukutti* did not take interest in irrigation matters due to the changes in the land ownership from the farmers to the real estate owners. The work done by them was also not good; SC = Scheduled Caste; LA = Less active; IA = Inactive; – indicates nil.

Source: Interviews conducted with experienced farmers and *thalaiyaries*, 1995.

Table A4.11: Maintenance/Repairs Undertaken in the System Tanks by PWD and *Ayacutdars*, 1990–91 — 1994–95

Tank Sl No	Repairs undertaken by the PWD			Repairs undertaken by the *ayacutdars*			
	Type of works	Year	Amount (Rs)	Type of works	(R)/(O)	Year	Amount (Rs)
1	2	3	4	5	6	7	8
Head-reach tanks							
1	Nil (No repair works done during the last 5 years. In 1970, PWD desilted the tankbed spending Rs 25,000	Nil	Nil	Sluice repairs only	O	1994	1,000
2	a) Desiltation of inlet-channels. b) Repairing of surplus weir, etc.	1991-92 1991-92	1,20,000 40,000	a) Construction of a small mud *kondam* on the surplus weir b) Purchase of new lockers for shutters c) Desiltation of the supply channel, etc.	R O R	1990-95 1994 1990-95	750 200 15,000
3	Desilting the tank to a small extent	1991-92	N.A	To remove the temporary obstructions in the supply channel by about 50 farmers.	R	1990-95	(Labour only)
4	a) Repairing of two sluices b) Desilting tankbed	1993-94 1992-93	N.A N.A	Nil	Nil	Nil	Nil
Middle-reach tanks							
5	Nil (Before 1980 desiltation works done partly.	Nil	Nil	a) Construction of a small mud wall on the surplus weir, b) Desilting the sluice mud, etc	O O	1993-94 1993-94	(Labour only) (Labour only)
6	Nil (Since 1984 no involvement)	Nil	Nil	Bought wooden shutters for the surplus weir	O	1990-91 1992-93	150
7	Nil (Before 1980 desiltation works done partly.	Nil	Nil	Wooden shutters for the sluices Desiltation of the Inlet channel	O R	1993-94 1990-95	400 (Labour only)
8	Nil (PWD repaired the *Peria madagu* before 1990. After that no work was done.	Nil	Nil	Sluice repair only (*Palla madagu*)	O	1994-95	6,000
9	Repairing of sluice only	1992-93	N.A	Nil	Nil	Nil	Nil
10	Repairing of sluice only (In 1980 tank desilted as a part of drought relief programme not very effective)	1992-93	N.A	Nil (Occasionally during emergency period only.In1986 about 150 farmers joined together to repair the *bund*)	Nil	Nil	Nil
11	Nil (In 1980 tank desilted to a small extent through drought relief programme)	Nil	Nil	Nil	Nil	Nil	Nil
Tail-reach tanks							
12	Nil (In 1982 tank desilted and sluice repaired. The total amount spent was Rs 45,000)	Nil	Nil	Nil	Nil	Nil	Nil
13	Nil (Before 1985 tank desilted partly)	Nil	Nil	Nil	Nil	Nil	Nil
14	Nil (In 1972 tank was desilted partly)	Nil	Nil	Nil	Nil	Nil	Nil
15	Nil (In 1981, tank was partly desilted and Thakkanrayapuram sluice repaired).	Nil	Nil	Nil	Nil	Nil	Nil
16	Sluice repair only, ie, *chinnamadagu*.	1994-95	N.A	Broken *bund* repaired by *ayacutdars*	O	1994	(labour only)
17	Nil	Nil	Nil	Nil	Nil	Nil	Nil
18	Nil	Nil	Nil	Nil	Nil	Nil	Nil

Note: NA = Not available; R = Regular; O = Occasional.
Source: Interviews conducted with experienced farmers and *thalaiyaries*, 1995.

Table A4.12: Maintenance/Repairs Undertaken in the Non-system Tanks by PWD and *Ayacutdars*, 1990-91-1994-95

Tank Sl No	Repairs undertaken by the PWD			Repairs undertaken by the *ayacutdars*			
	Type of works	Year	Amount (Rs)	Type of works	(R)/(O)	Year	Amount (Rs)
1	2	3	4	5	6	7	8
Head-reach tanks							
1	Nil (No repair work done during the last five years. But in 1986, PWD desilted the tankbed to a small extent).	Nil	Nil	Nil	Nil	Nil	Nil
2	Nil (In 1982 tank desilted as a part of drought relief programme)	Nil	Nil	Nil	Nil	Nil	Nil
3	Sluice repair(Mettu madagu) (Reported to be not good)	1992	N.A	Nil	Nil	Nil	Nil
4	Nil	Nil	Nil	Construction of mud *kondam* by the tail-end farmers	O	1993	(Labour only)
5	Nil	Nil	Nil	nil	R	90-95	(Labour only)
6	(In 1980 tank desilted as a part of Drought relief programme)	Nil	Nil	Nil	Nil	Nil	
7	Sluice repairs only	1990	N.A	Nil	Nil	Nil	Nil
Middle-reach tanks							
8	Nil (After 1975 there was no maintenance done by PWD	Nil	Nil	Nil	Nil	Nil	Nil
9	Nil (In 1982 tank desilted as a part of drought relief programme)	Nil	Nil	Sluice repairs (*chinna madagu*)	O	1995	2500
10	Strenthening of the tank *bund*	1995	N.A	To repair the broken *bund*	O	1994	(Labour only)
11	Nil (No work was done by the PWD after 1982)	Nil	Nil	Nil	Nil	Nil	Nil
12	Repairing of two sluices	1993	N.A	Construction of mud wall on the surplus weir	R	90-95	300-500
13	Nil (During the year 1980 desiltation work done partly) in the inlet channel	Nil	Nil	a) Bought wooden shutters for the sluices b) Minor repairs in	O O	1994 1993	200 500
14	Nil	Nil	Nil	Demolished a house constructed illegally on the supply channel	O	1993	(Labour only)
15	Nil (No work was done PWD after 1985)	Nil	Nil	Plug the breaches of tank *bund* in 10 places	O	1994	(Labour only)
Tail-reach tanks							
16	Repairing of broken *bund* and sluice (peria madagu) using mud and stones etc.	1992	N.A	a) To repair the broken *bund* b) Closing of sluices	O R	1992 1990-95	(Labour only)
17	a) Surplus weir repairs b) Repair of broken *bund* etc.	1992	N.A	Removed the temporary mud *kondams* constructed by upstream farmers	R	1990-95	3000
18	Desilted about three feet near Pallamadagu in the rainy season only	1994	N.A	Strengthening of the surplus weir during	O	1994	(Labour only)
19	Nil (During the year 1982 desiltation work done partly)	Nil	Nil	a) To repair the broken *bund* in 5 places b) Making wooden	O O	1995 1994	(Labour only) (Labour only)
20	Nil (After 1970 no main-tenance was dobe by PWD)	Nil	Nil	Nil	Nil	Nil	Nil
21	Desilted the tank partly	1992	N.A	a) Whenever tank *bund* was broken people joined together to plug the breaches b) Digging of inlet channel is done every year	R R	1990-95 1990-95	(Labour only) (Labour only)
22	Nil (No work was done by PWD for several years)	Nil	Nil	Nil	Nil	Nil	Nil

Note: NA = Not available; R = Regular; O = Occasional.
Source: Interviews conducted with experienced farmers and Thalaiyaries, 1995.

Table A4.13: Maintenance/Repairs Undertaken in the Palar System Tanks by *Ayacutdars*, 1994-95

Tank Sl No	Type of channel A. Inlet B. Main/ Branch C. Field	No of times work done during last 5 years	Details of work done in 1994-95							Extent of partici-pation	Remarks
			No of times work done	Labour mandays		Rate of labour/ day	Total contri-bution (Rs)	Basis of contri-bution Acre/HH	Penalty/ day (Rs)		
				Own	Hired						
1	2	3	4	5	6	7	8	9	10	11	12
Head-reach tanks											
1	A	0	0	–	–	–	–	–	–	–	–
	B	0	0	–	–	–	–	–	–	–	–
	C	0	0	–	–	–	–	–	–	–	–
2	A	0	0	0	0	0	0	0	0		After weeding
	B	5	1	75	0	0	0	One person/acre	0	V. good	
	C	5	1	0	0	0					
3	A	5	1	0	50	10	500	Rs 10/acre	0	Satis– factory	(Only tail-enders took much interest) Before transplanting and after weeding
	B	5	2	80	0	0	0	One person/HH			
	C	5	2	20	0	0	0				
4	A	0	0	0	0	0	0	0	0	Good	After weeding
	B	3	1	60	0	0	0	One person/HH			
	C	3	1								
Middle-reach tanks											
5	A	0	0	0	0	0	0	0	0	Good	During water scarcity period only (1990 &1993)
	B	2	1	50	0	0	0	One person/HH	0		
	C	2	1	30	0	0	0				
6	A	0	0	0	0	0	0	0	0	Good	Before transplanting
	B	5	1	0	200	10	2000	Rs 10//farmer	0	Good	
	C	5	1	150	0	0	0	One person/HH	0		
7	A	5	1	80	0	0	0	Entire *ayacut* is divided into 5 divisions each division consists of 8 farmers.	*	V.good	a)Works undertaken before opening of sluices. (b) out of 80 labourers 40 were from Sirukaveripakkam.
	B	5	1	40	0	0	0				
	C	5	1	40	0	0	0				
8	A	0	0								Main/field channels encroached since 1985. Field to field irrigation is practised.
	B	0	0								
	C	0	0								
9	A	0	0								No surplus since 1965. Majority of farmers shifted their occupation from agriculture to silk weaving.
	B	0	0								
	C	0	0								
10	A	0	0	0	0	0	0	0	0		Works undertaken before weeding. Field channels are encroached on by adjacent ayacutdars. Field to field irrigation is practised
	B	5	1	100	0	0	0	One person/HH	0	Good	
	C	0	0	0	0	0	0	0	0		
11	A	0	0	0	0	0	0	0	0	Unsatis- factory	It is done only when water level in the tank is reduced.
	B	5	1	10	0	0	0	Some interested farmers of the head reach only	0		
	C	5	1	10	0	0	0		0		
Tail-reach tanks											
12	A	0	0	0	0	0	0	0	0	Unsatis- factory	Work done only during water scarcity period.
	B	5	1	50-60	0	0	0	One person/HH	0		
	C	5	1		0	0	0		0		

Continued

Continued A4.13

Tank Sl No	Type of channel A. Inlet B. Main/ Branch C. Field	No of times work done during last 5 years	Details of work done in 1994-95						Penalty/ day (Rs)	Extent of participation	Remarks
			No of times work done	Labour mandays		Rate of labour/ day	Total contribution (Rs)	Basis of contribution Acre/HH			
				Own	Hired						
1	2	3	4	5	6	7	8	9	10	11	12
13	A	0	0								Since 1989 there was no maintenance work due to lack of co-operation.
	B	0	0								
	C	0	0								
14	A	0	0								Since 1987 no maintenance work undertaken. Channels are encroached by adjacent *ayacutdars*.
	B	0	0								
	C	0	0								
15	A	0	0	0	0	0	0	0	0	Good	Works undertaken before weeding. per h.hold
	B	5	1	150	0	0	0	One person/HH	0		
	C	5	1	0	0	0					
16	A	0	0	0	0	0	0	0	0	Satis-factory	During water scarcity period after weeding.
	B	4	1	200	0	0	0	2 persons/acre			
	C	4	1								
17	A	0	0	0	0	0	0	0	0	Good	Tail-enders did maintenance during second season when supply was reduced
	B	5	1	300	0	0	0	One person/HH	0		
	C	5	1								
18	A	0	0								No maintenance works since 1990 due to implementation of EEC scheme.
	B	0	0								
	C	0	0								

Note: * = Rs 10 per person, Since farmers' participation is active in this tank, fine is not collected since 1990; HH = Household.
Source: Interviews conducted with experienced farmers and *thalaiyaries*, 1995.

Table A4.14: Maintenance/Repairs Undertaken in the Palar Non-system Tanks by the *Ayacutdars*, 1994–95

Tank Sl No	Type of channel A. Inlet B. Main/ Branch C. Field	No of times work done during last 5 years	Details of work done in 1994-95						Penalty/ day (Rs)	Extent of participation	Remarks
			No of times work done	Labour mandays		Rate of labour/ day	Total contribution (Rs)	Basis of contribution Acre/HH			
				Own	Hired						
1	2	3	4	5	6	7	8	9	10	11	12
Head-reach tanks											
1	A	0	0								No maintenance works since 1990 due to implementation of EEC scheme.
	B	0	0								
	C	0	0								
2	A	0	0	0	0	Nil	Nil	Nil	Nil	Nil	Head reach farmers Unsatis-factory
	B	2	1	50	0	Nil	Nil	Nil	Nil		
	C	2	1	50	0	Nil	Nil	Nil	Nil		
3	A	0	0								Since 1985 no maintenance due to inadequate supply.
	B	0	0								
	C	0	0								
4	A	0	0	0	0	Nil	Nil	Nil	Nil	Nil	About 40 farmers of head reach took interest
	B	10	2	40	0	Nil	Nil	Nil	Nil	Unsatis-	
	C	10	2	0	Nil	Nil	Nil	Nil		factory	
5	A	0	0	0	0	Nil	Nil	Nil	Nil	Nil	No field channels are there as the tank is new.
	B	5	1	60	0	Nil	Nil	Nil	Nil	Good	
	C	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	
6	A	0	0								Main and field channels are not maintained since 1975 due to encroachment.
	B	0	0								
	C	0	0								
7	A	0	0								
	B	0	0								
	C	0	0								
Middle-reach tanks											
8	A	0	0								
	B	0	0								
	C	0	0								
9	A	0	0	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Field channels are desilted by *kammukutti*
	B	5	1	150	Nil	Nil	Nil	1 person/house hold	Nil	Good	
	C	5	1	20	Nil	Nil	Nil		Nil	Good	
10	A	0	0								
	B	0	0								
	C	0	0								
11	A	0	0	0	Nil	Nil	Nil	Nil	Nil	Nil	Very few farmers took interest
	B	5	1	25	Nil	Nil	Nil	Nil	Nil	Bad	
	C	5	1		Nil	Nil	Nil	Nil	Nil	Nil	
12	A	0	0	0	Nil	Nil	Nil	Nil	Nil	Nil	Big farmers only involved
	B	5	1	30	Nil	Nil	Nil	Nil	Nil	Bad	
	C	5	1		Nil	Nil	Nil	Nil	Nil	Nil	
13	A	6	2	Nil	50	10	500	1 acre/Rs 10	Nil	V.good	Big farmers contributed Rs 50/acre
	B	6	2	Nil	15	25	375				
	C	10	2	Nil	10	25	250				
14	A	0	0	0	Nil	Nil	Nil	Nil	Nil	Nil	
	B	5	1	80	Nil	Nil	Nil	1 person/house hold	Nil	Good	
	C	5	1		Nil	Nil	Nil		Nil		

Continued

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Tank Sl No	Type of channel A. Inlet B. Main/ Branch C. Field	No of times work done during last 5 years	Details of work done in 1994-95						Penalty/ day (Rs)	Extent of partici-pation	Remarks
			No of times work done	Labour mandays		Rate of labour/ day	Total contri-bution (Rs)	Basis of contri-bution acre/HH			
				Own	Hired						
1	2	3	4	5	6	7	8	9	10	11	12
15	A	0	0	Nil	Nil	Nil	Nil	Nil	Nil		
	B	20	4	480	Nil	Nil	Nil	1 person/house hold	Nil	Very good	
	C	20	4	Nil	Nil	Nil					
Tail-reach tanks											
16	A	0	0								
	B	0	0								
	C	0	0								
17	A	0	0	Nil	Nil	Nil	Nil	Nil	Nil	Nil	
	B	5	1	50	Nil	Nil	Nil	1 person/house hold	Nil	Good	
	C	5	1	Nil	Nil	Nil	Nil				
18	A	0	0	Nil	Nil	Nil	nil	Nil	Nil	Nil	
	B	10	2	120	Nil	Nil	Nil	1 person/house hold	Nil	Good	
	C	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	
19	A	0	0	Nil	Nil	Nil	Nil	Nil	Nil	Nil	
	B	5	1	100	Nil	Nil	Nil	1 person/house hold	Nil	Good	
	C	5	1	Nil	Nil	Nil	Nil				
20	A	0	0								Branch/field channels are encroached on
	B	0	0								
	C	0	0								
21	A	5	1	50	Nil	Nil	Nil	1 person/house hold	Nil	Good	
	B	5	1	Nil	Nil		Nil		Nil		
	C	5	1	Nil	Nil		Nil		Nil		
22	A	0	0	Nil	Nil	Nil	Nil		Nil	Nil	Thiruppukuli villagers participated more as their lands were under *palla madagu*
	B	5	1	Nil	120	25	3000	Rs 25/person	Nil	Bad	
	C	Nil	Nil	Nil	Nil	Nil	Nil		Nil		

Source: Interviews conducted with experienced farmers and *thalaiyaries*, 1995.

Table A4.15: Funds Maintained by Organisation in the Palar Sytem Tanks, 1994–95

Tank Sl No	Tank/ village both	Amount (Rs)	Sources	Purpose of utilisation
1	2	3	4	5
Head-reach tanks				
1	Nil			
2	Both	7000	a) *Pillayar* fund is raised through collection of Rs 15-20/acre from farmers (Rs 3,000) b) *Manmathan* fund is raised through collection of paddy from willing and capable persons. Approximately 30 bags (Rs 250/bag) are collected.	a) Desilation of inlet channel, payment of wages for labourers appointed as watchmen. b) Utilised for festivals and tank-related purposes. For instance, in 1994, about Rs 4,000 spent on festivals, Rs 150 on constructing a small mud wall on S. weir for raising the level and Rs 200 on purchase of locks for shutters, etc.
3	Nil			
4	Nil			
Middle-reach tanks				
5	Village fund	150	Mobilised from tending ducks	Temple festivals only
6	Both	8150	a) Mobilised from tending ducks b) Tree auctioning etc.	a) Bought wooden shutters for Rs 3,150. b) Remaining for village festivals
7	Tank fund	300	a) Mobilised from tending ducks b) Collection of fine etc.	It is mainly used for maintenance of channels and other tank-related purposes only.
8	Both	8500	a) Mobilised from tending ducks Rs 500 b) Auctioning of trees, Rs 8,000 (Every 4 years).	a) Sluice repairing and other minor works for Rs 6,500. b) The remaining for temple festivals.
9	Nil			
10	Nil			
11	Nil			
Tail-reach tanks				
12	Nil			
13	Village fund	10000	b) Auctioning of trees (Every 4 years).	Temple affairs only.
14	Nil			
15	Nil			
16	Nil			
17	Nil			
18	Nil			

Source: Interviews conducted with experienced farmers and *thalaiyaries*, 1995.

Table A4.16: Funds Maintained by Organisation in the Palar Non-sytem Tanks, 1994-95

Tank Sl No	Tank/ village both	Amount (Rs)	Sources	Purpose of Utilisation
1	2	3	4	5
Head-reach tanks				
1	Nil			
2	Nil			
3	Nil			
4	Nil			
5	Nil			
6	Nil			
7	Nil			
Middle-reach tanks				
8	Nil			
9	Village	1,000	Auctioning of trees once in 3 years	*Bund* and Sluice repairs
10	Village fund	3,000	Auctioning of trees once in 3 years	Village festivals
11	Village fund	10,000	Auctioning of trees once in 3 years	Village festivals
12	Tank fund	1,000	Big farmers contribution	Construction of mud kondam on the s.weir
13	Tank fund	1,000	Tending of ducks	Making wooden shutters/minor repairs etc.
14	Tank fund	3,000	Tree and fish auctioning	Minor repairs only.
15	Both	750	Duck fund	Village festivals and making wooden shutters for the sluices
Tail-reach tanks				
16	Village fund	300	Tending of ducks	Village festivals
17	Both	10,300	Tree auctioning and duck fund.	Village festivals and making wooden shutters for the sluices
18	Tank fund	2,500	Duck fund	Minor repairs for sluices and s. weir etc.
19	Both	500	Duck fund	Village festivals and making wooden shutters for the sluices
20	Nil			NIL
21	Village fund	500	Duck fund	Village festivals
22	Nil			NIL

Source: Interviews conducted with experienced farmers and *thalaiyaries*, 1995.

Table A4.17: Water Allocation in the Palar System Tanks, 1994–95

Tank Sl No	Responsibility for sluice operation	Regulation of area under crop/timing when the supply is inadequate	Method adopted during normal times	Method of water allocation during shortage of the tank supply (*murai system, orumadai-paichal,* tail-to-head & others)	Details about dispute in allocating water
1	2	3	4	5	6
Head-reach tanks					
1	*Thotti*	Nil	Nil	Nil	Nil
2	Farmers themselves involved	Nil	Nil	*Orumadai paichal* was adopted in 1987 & 1991 when the water level in the tank decreased to one month supply. It is reported that the system worked well in 1987 only when a single person was involved in the management of the tank. But in 1991, it failed mainly due to lack of cooperation and dedicated leadership.	Disputes exist bettween *boyar* & others.In 1991 it was resolved to use water only during day time. However, it was reported that *boyar* opened sluices illegally & used water which led to disputes.Their lands were concentrated in the head reach & tried to lock the shutters, not allowing water to others. This led to breaking .of lockers some times
3	Farmers	Nil	Nil	Nil	Disputes are very common and settled locally
4	*Thotti* (whenever a of of farmers asked him to do so)	Nil	Nil	Nil	Nil
5	*Thotti*	During the year 1994 the area under crop sown was restricted for 25 cents/farmer to raise dry crops only. The decision was made by *nattamai* along with *ayacutdars*	Nil	a) During the year 1993-94,the system was adopted from tail-to-head and lost for 1-1/2 months watering was mainly done by *thotties* on the advice of *nattamaies*. Overall the system is working well. b) Using death storage water: during the year 1994-95, *murai* was adopted to lift water from the tank when the water supply was of about 15-20 days. According to this *murai* system one can lift water for about 3 hours/day by using oil engine.	Disputes occurred very often, but locally settled. No court case was registered.
Middle-reach tanks					
6	*Kammukutti* takes the responsibility on the advice given by *peria thanakkarar.*	During the *navarai* season (1993-94) the area was restricted from 350 to 400 acres only. But it failed due to lack of unity among farmers.	Nil	Nil	Disputes occurred very often, but locally settled. No court case was registered.
7	*Kammukutti* takes the responsibility whenever *kavaimaniyam* asks him to do so.	Nil	Nil	Murai is adopted only when the water level in the tank is decreased i.e, 20-30 days.The entire *ayacut* is divided into five divisions &under each division, 60 acres are allotted. One division gets water supply from 6a.m to 6p.m only on rotation basis. After 6pm water is diverted to another division. The same division will get water again only after two and half days depending upon the water availability.In each division there are 8 farmers sharing the water. The names of the divisions are 1) *adi vattam,* 2nd *vattam,* 3rd *vattam,* 4th *vattam* 5th *vattam,* 6th *vattam,* 7th *vattam,* 8th *vattam.*	Because of the prevalence of *murai* system, the possibility of conflicts among the farmers is minimum in this village.
8	Kammukutti takes the responsibility on the advice given by *nattamaies.*	Nil	Nil	Nil (Before 20 years *nattamai* was very strong in this village when Kanniappa Naicker was alive. At that time he looked after all the affairs of the village including irrigation. During the scarcity period, murai was implemented by him. After he died,nobody is taking effective steps to adopt this method.	a) Disputes occurred very often & farmers settled them by themselves. b) During 1955 &1977 conflicts arose between this village and Damal as the *bund* was illegally broken by them to drain water. Police case was registered, and finally compromised by the police.
9	Nobody is taking responsibility.	Nil	Nil	Nil (*Murai* was there 6-7 years ago. At that time they used an instrument called "PALLA" to measure the time for rotation. Kavaimaniyam took the responsibilities of implementing *murai* system and maintenance. In the recent years there are no such functionaries in this village due to lack of dedicated leadership & co-operation)	Disputes are settled locally.

Continued

Continue A4.17

1	2	3	4	5	6
10	Thotti (*perunthanakkarar* gives advice to *thotti* for sluice operations depending upon the water availability)	Nil	Nil	*Orumadai paichal* is adopted only during water scarcity period of *navarai* season.It is followed and farmers lasts for 1-1/2 months. About 10-20 important gather together & take decisions. It works well with some problems. But it is reported that the water managemant was done effectively by the heriditary *nattamai* 20 years ago.	Disputes are there, but settled locally.
11	*Kammukutti* (No responsible person to take decisions for sluice operation, but about 10-20 farmers of head reach took interest and asked him to do so.	Nil	Nil	Nil	Disputes are there but not very serious.
Tail-reach tanks					
12	No *kammukutti* (but farmers themselves involved)	Nil	Nil	Nil	Disputes occurred very often, but locally settled. No court case was registered.
13	No responsible person in this village for sluice operations. But a few farmers took interest which was not very effective.	Nil	Nil	Nil (Earlier *nattamai* with *murai* system i.e, twenty years ago in the water scarcity periods for about 10-20 days *murai* was adopted for 1/2 an hour/acre. It disappeared after passing away of heritidary *nattanmaies* like Srinivasaachari Govindachari and Veeraragavaachari etc.)	Conflicts are always there whenever water supply is inadequate.
14	No responsible person in this village for sluice operations. It is opened always without closing.	Nil	Nil	Nil (*Murai* was there 20 years ago. At that time they used an instrument called "PALLA" to measure the time for rotation. *Nattanmai* took the responsibility of implementing murai system & maintenance etc. In the recent years there are such functionaries in this village after passing away of heritary *nattamai* viz, Govindasamy reddyar, Kuppusamy Chettiar and Boobala Nainar)	Disputes are very common & are settled locally by elders.
15	*Thotti*	Nil	Nil	*Murai* is adopted within in the village and also by the other village farmers when water supply in the tank is of about 15-20 days.It is divided into three parts viz, 1st turn,2nd turn,3rd turn respectively. The allotted time for each turn is 12 hours/day. The sampled village ayacutdars could get water for 24 hours i.e., 1st two turns are used by our sampled village farmers.The third turn is used by the Nanjambadi *ayacutdars* depending upon the water availability.	Dispute occurred but not very serious.
16	No responsible person in this village for sluice operations. But a few farmers took interest which was not very effective.	Nil	Nil	Nil (*Orumadai paichal* was followed in the village 30 years ago when *nattamai* took responsibilities.Due to changes in the land ownership, social attitude &water scarcity it dissapeared slowly)	Disputes occurred during water scrcity period and solved by themselves.
17	No responsible person in this village for sluice operations.But some times a few farmers took interest.	If the tank is not filled up they used to raise "pulithikar" (Vaigunda & other varieties). In 1992 when the tank supply was meagre, the above method was followed.	Nil	Nil (Earlier, i.e., 25-30 years ago, Nattamai with *murai* system was common in this village. When there was water shortage, he arranged meetings with the *ayacutdars* in order to share the available water. The rotation schedule (*orumadaipaichal*) was decided by the farmers & *nattamaies* together. Decipline was framed & all of them irrigated their field strictly in accordance with the turns already fixed by the village elders.In the recent years the system has been gradually disappearing due to the traditional *nattamaies* death.	Freqent quarrels arose between the upstream tank villagers (*Soraputheri*) due to the surplus weir of the above said tank is illegally raised for about two feet in order to store more water. There is no court case against this. But it is solved by themselves)
18	No responsible person in this village for sluice operations. But a very few farmers took interest which was not very effective.	Nil	Nil	Nil (10-15 years ago, during the water sacrcity period, *nattamai* took the responsibilities of implementing *orumadai paichal* on rotation basis)	Not very common

Source: Interviews conducted with experienced farmers and *thalaiyaries*, 1995.

Table A4.18: Water Allocation in the Palar Non-System Tanks, 1994–95

Tank Sl No	Responsibility for sluice operation	Regulation of area under crop/timing when the supply is inadequate	Method adopted during normal times	Method of water allocation during shortage of tank supply (*murai* system, *orumadai-paichal*, Tail-to-head & others)	Details about dispute in allocating water
1	2	3	4	5	6
Head-reach tanks					
1	No responsible person in this village for sluice operations. A few farmers took interest & it is very effective.	Nil	Nil	Nil	Disputes are very common and settled by farmers themselves
2	*Thotti* (whenever a group of farmers asked him to do so)	Nil	Nil	Nil	Disputes are very common and settled by farmers themselves
3	Farmers themselves took interest.	Nil	Nil	Nil (*Orumadai paichal* with time was followed in this village before 1975 when Brahmins took responsibilities. Due to changes in the land ownership, social attitude & water scarcity it disappeared slowly).	Disputes arose very often, but locally settled. No court case was registered.
4	*Kammukutti* takes responsibility depending upon water availability.	Nil	Nil	Nil	Disputes arose very often, but locally settled. No court case was registered.
5	Nil	Nil	Nil	Nil (As the tank is new and a major portion of *ayacut* does not get water supply, organisation and collective efforts by farmers have not developed.	Nil Disputes arose very often, but locally settled. No court case was registered.
6	*Thotties*	Nil	Nil	Nil (*Murai* was there 20 years ago when Muthu pillai (*periathanakkarar*) took responsibilities. They used an instrument called "Palla" to measure the time for rotation. In recent years it disappeared after passing away of Muthu *pillai* due to lack of dedicated leadership.	Disputes are very common and settled by farmers themselves
7	Nobody is taking responsibility.	Nil	Nil	Nil (Murai was there 20 years ago when Ramanatha Udayar/*kavaimaniyam* took responsibilities. During scarcity period water was allowed one hour/acre depending upon the water availability in the tank. After he passed away nobody took initiative in such organisational matters).	Mild disputes only
Middle-reach tanks					
8	*Kammukutties* took the responsibilities on the basis of their experience and whenever the farmers as a group asked them to do so.	Nil	Nil	Nil (Murai was there 15 years ago when *kavaimaniyam* took responsibilities. After passing away of *kavaimaniyam*	There used to be a lot of disputes during scarcity as there was no rationing system followed for last seven years. No one came forward to do that).
9	*Kammukutti* took the responsibilities on the advice given by *nattamai*	Nil	Nil	*Orumadai paichal* method is followed when the water level in the tank decreases to 1 month. Watering is mainly done by the *thotties* on the advice of *nattamaies*. Over all the system is working well.	Disputes are there in the tail-end, but settled locally.
10	*Kammukutti* took the responsibilities.But in the recent years due to lack of irrigation organisation he is inactive.	Nil	Nil	Nil (Twenty years ago there was farmers organisation to look after the irrigation affairs in this village. But in recent years due to changes in land ownership, i.e., conversion of agricultural lands into house sites led to failure of the *kudimaramath* system.	Nil (Due to adequate water supply there is no possibility of conflicts among farmers)
11	A few farmers of head reach took the responsibilities, but that is not very effective.	Nil	Nil	Nil (Thirty years ago there was farmers organisation In recent years due to the disappearence of the *kasam*, the tank do not get adequate water and hence farmers of this village mainly depend upon the well water only which led to disappearance of the irrigation organisation).	Frequent conflicts are reported during the water scarcity period which farmers solve by themselves

Continued

Continued A4.18

1	2	3	4	5	6
12	*Vettiyans* seek advice from some knowledgeable farmers for opening/closing of sluices.	Nil	Nil	*Orumadai paichal* method is followed during the scarcity period. During *navarai* season, before transplantation a meeting of the *ayacutdars* is conducted every year. The ex-president takes initiative for organising the meeting in which *ayacutdars* from head reaches do not take interest. The turn system is announced in the meeting. *Vettiyan* goes around the field and diverts water to fields which require water. One person is also appointed to help the Vettiyans. Farmers do not involve themselves in watering during such times. The system is reported worked well.	Mild disputes occured and settled locally.
13	Undertaken by the *kammukutties* as decided by the farmers under the direction of *nattamaies*	Nil	Nil	*Orumadai paichal* method was implemented in 1990 during the water scarcity period. Water was supplied to each channel for one week on rotation basis depending upon water availability. At that time coolies were also appointed along with *kummukutties* for watering the field effectively. It is reported that it works well.	Before 1983 the *punjai* land owners took water illegally and it paved the way for conflicts.At that time a fine the dispute of Rs 50 was collected from each one and settled amicably.After that no conflicts arose.
14	Undertaken by the *kammukutties* as decided by the direction farmers under the of *panchayatdars*	Nil	Nil	*Murai* system is followed during scarcity period. The entire *ayacut* is divided into 6 *pangus* and each *pangu* roughly accounts for 75 acres. Each *pangu* gets water once in 6 days by rotation. The duration of supply is 12 hours from 6 a.m to 6p.m in a day. On an average one acre gets supply for 15 minutes. *Kammukutties* irrigate the field according to this scheme. Once the *murai* system is announced farmers are not allowed to irrigate. If there is any violation fine is also levied. The *murai* system seems to be successful as the number of farmers owning land is less and concentrated in a few hands.	No possibilities of disputes due to the implementation of the effective *murai* system
Tail-reach tanks					
15	Undertaken by the *kammukutti* under the direction of *kavaimaniyam*	Nil	Nil	*Pangu* system:- *Murai* is adopted only when water level in the tank decreases to one month. There are 14 *pangus*. Each *pangu* consists of 2-4 farmers. Each farmer from one *pangu* gets water supply for one hour twelve minutes only. The same person gets water again after 2 days depending upon the water availability. The order of priority of the *pangu* holders to irrigate their field is decided by drawing lots. Water is used only by these *pangu* holders during scarcity period. The *pangu* holders are have the right to sell to or exchange their water rights with other farmers depending upon the availability of water. *Kammukutti* takes the responsibility of irrigating the lands as advised by the *kavaimaniyam*. During night time also irrigation is done and it works well.	Disputes arise very rarely and are settled by themselves.
16	The *ayacutdars* themselves took interest in opening/closing of sluices based on the water availability in the tank.	Nil	Nil	Nil	Disputes are very common among farmers while taking water and are solved by themselves
17	Depending upon the water availability the *nattamaies* asked *kammukutti* to open/ close the sluices	Nil	Nil	*Orumadai paichal* method is adopted almost every year during scarcity time, especially in the second season. The rotation of supply is followed between two deepest sluices once in three days. *Kammukutti* is responsible for watering and *nattanmai* supervise, the work. It is reported to work well.	Not very common due to implementation of the *murai* system.
18	*Nattamaies* are responsible for taking decision and *kammukutti* implements the decision	Nil	Nil	Nil (Generally, there is no water problem in this tank)	Nil

Continued

Continued A4.18

1	2	3	4	5	6
19	On the advice of *peria-thanakkarar* kammukutti undertakes the operation	Nil	Nil	*Orumadai paichal* with tail to head method is followed during scarcity period.The method was adopted in 1992 and 1993 as the tank was not filled up properly. The water was supplied to each channel from tail-to-head for one week on rotation basis, depending upon water availability. The rotation of supply was followed between two deepest sluices. Watering is mainly done by *kummukutties* and *nattamaies* supervise the work. In order to avoid loss of water, irrigation is not done during night time is it works well.	Mild disputes only and settled locally.
20	Nobody is taking responsibility	Nil	Nil	Nil (*Murai* was there before 1980 during scarcity period. The entire *ayacut* had been divided into 12 shares. Each share roughly accounts for 18.5 *kanies*. The average number of hours fixed for one share is 3 hours/time only. It worked well, but in recent times it disappeared due to changes in the land ownership and lack of collective action.)	Frequent quarells arise between the head and tail-reach farmers during the scarcity period due to the meagre water supply from the tank. The disputes are settled locally.
21	Undertaken by the *kammukutties* under the direction of *nattamaies*	Nil	Nil	*Pangu* system: The whole *ayacut* have been divided in to 8 shares and rationing of water is based on rotation of shares. One share is entitled for water supply for one day. The lands are distributed in such a manner that the *pangu* system benefits both head and tail-reaches.	Nil
22	No person is responsible for sluice operation. The *kammukutti* opens sluices whenever some farmers need water, join together and ask him to do so. Some times even the *ayacutdars* themselves open it.	Nil	Nil	Nil	There used to be a lot of disputes among *ayacutdars*, especially during scarcity times. It is commented by them that those who have muscle power and influence in the village get more water supply.

Source: Interviews conducted with experienced farmers and *thalaiyaries*, 1995.

Table A4.19: Performance Rating of Selected System and Non-sytem Tanks Under the Palar Basin

Tank Sl No	Conditions of physical structures T.Bund :1 T.Bed :1 S & CS :2 S. Weir :1 IC :1	Maintenance done in 5 years IC M/B FC <——> 1 to 3 times :1 4 to 5 times :2 > 5 times :3		Repairs undertaken by PWD and ayacutdars 0 year = 0 1 year = 1 2 – 3 = 2 4 + = 3	No of irrigation functioneries		Prevalence of rationing Yes :1 No :0	Caste Multi – 1 Single – 2	No of months water supply 1-3 =1 3 – 5 = 2 5 + = 3	Min/max .01-.40=1 .41-.80=2 .80 + = 3	Wells/ 100 ha 1-50 = 1 50-100=2 > 100 =3	Imposition of penalty Yes = 1 No = 0	Total Col 3 to 9	Points Col 3 to 14	Location
					Higher level Nil : 0 Natt-amai-1	Lower level Nil : 0 *1 =1 *2 =2									
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
System tanks																
1	2	0	0	0	1	0	1	0	2	1	2	3	0	2	10	H
2	2	0	2	2	3	1	1	1	2	2	3	1	0	10	18	H
3	2	2	2	2	3	0	0	0	2	2	3	1	0	9	17	H
4	2	0	1	1	2	0	1	0	2	1	3	2	0	5	13	H
5	0	0	1	1	1	1	1	1	1	1	1	0	0	6	9	M
6	1	0	2	2	2	1	1	0	1	1	2	0	0	8	12	M
7	2	2	2	2	3	1	1	1	1	1	2	1	1	12	18	M
8	1	0	0	0	1	1	1	0	2	1	1	1	0	3	8	M
9	2	0	0	0	1	0	0	0	2	1	1	1	0	1	6	M
10	1	0	2	0	1	1	2	1	1	1	2	0	0	7	11	M
11	1	0	2	2	0	0	1	0	1	1	2	1	0	5	10	M
12	3	0	2	2	0	0	0	0	2	1	1	1	0	4	9	T
13	2	0	0	0	0	0	0	0	2	1	2	3	0	0	8	T
14	2	0	0	0	0	0	0	0	1	2	2	2	0	0	7	T
15	1	0	2	2	0	1	2	1	2	1	1	3	0	8	15	T
16	0	0	2	2	1	0	0	0	2	2	2	1	0	5	12	T
17	1	0	2	2	0	0	0	0	2	2	2	2	0	4	12	T
18	1	0	0	0	0	1	0	0	2	1	2	2	0	1	8	T
Non-system tanks																
1	1	0	0	0	0	0	0	0	2	1	1	3	0	0	7	H
2	1	0	1	1	0	0	1	0	2	1	1	3	0	3	10	H
3	0	0	0	0	1	0	0	0	1	1	1	2	0	1	6	H
4	2	0	3	2	1	0	1	0	1	1	2	2	0	7	13	H
5	2	0	2	0	3	0	0	0	2	3	3	1	0	5	14	H
6	1	0	0	0	0	0	2	0	2	1	1	2	0	2	8	H
7	1	0	0	0	1	0	0	0	1	1	1	2	1	1	7	H
8	1	0	0	0	0	1	1	0	2	2	2	0	0	2	8	M
9	0	0	2	2	1	1	1	1	1	1	2	0	0	8	12	M
10	2	0	0	0	1	0	1	0	1	3	3	1	0	2	10	M
11	1	0	2	2	0	0	0	0	2	1	2	3	0	4	12	M
12	0	0	2	2	3	0	1	1	2	1	3	0	0	9	15	M
13	0	3	3	3	2	1	1	1	1	2	3	0	0	14	20	M
14	0	0	2	2	1	1	1	1	2	1	2	1	0	8	14	M
15	2	0	3	3	1	1	2	1	1	1	1	1	0	11	15	M
16	1	0	0	0	3	0	0	0	2	1	–	2	0	3	8	T
17	1	0	2	2	3	1	1	1	1	2	3	1	0	10	17	T
18	1	0	3	0	1	1	1	0	1	3	3	0	0	6	13	T
19	1	0	2	2	1	1	1	1	2	1	1	1	0	8	13	T
20	0	0	0	0	0	0	0	0	2	1	2	2	0	0	7	T
21	1	2	2	2	3	1	1	1	2	1	2	1	0	12	18	T
22	1	0	2	0	0	0	1	0	2	1	2	1	0	3	9	T

Note: *1 Person for more than 40 hectares; *2 One person for less than 40 hectares; Numbers (0,1,2,3) as given in the column headings refer to the points of respective categories; IC = Inlet Channel; M/B = Main/Branch Channels.; FC = Field Channel.

Source: Survey, 1995.

Chapter 5

KAVERIPAKKAM AND DUSI-MAMANDUR TANKS

K Sivasubramaniyan

This paper describes the main features of the organisation and functioning of two of the largest multi-village tanks of Tamil Nadu: namely Kaveripakkam (KPT) and Dusi Mamundur (DMT). Both are part of the Palar anicut system (PAS), situated in the northern parts of the state and spread over three districts namely, North Arcot, Thiruvannamalai and Chengalpattu.

KPT is situated close to Palar anicut at the head of one of the north bank channels drawn from the *anicut* while DMT is at the tail-end of a channel on the south bank of the river (*see Map 5.1*). Being at the head, KPT gets relatively more assured supplies from the system than DMT. The latter in fact relies for more on diversion of river flow down stream of the Palar anicut, (i.e., the Rajakkal channel) than from the PAS itself. On the other hand the DMT has a larger storage capacity per unit of *ayacut* area than the KPT.

KPT has an *ayacut* of around 2,500 ha spread over 14 villages and fed by 10 sluices of varying elevations. Channels drawn from more than one sluice feed several of the *ayacut* villages. DMT has four sluices and irrigates around 1,700 ha spread over 18 villages. Unlike in KPT, each DMT village gets water supply from one set of sluices operated in combination. Since sluice levels differ significantly in terms of elevation, the quantum, duration and assurance of water supply vary greatly between villages.

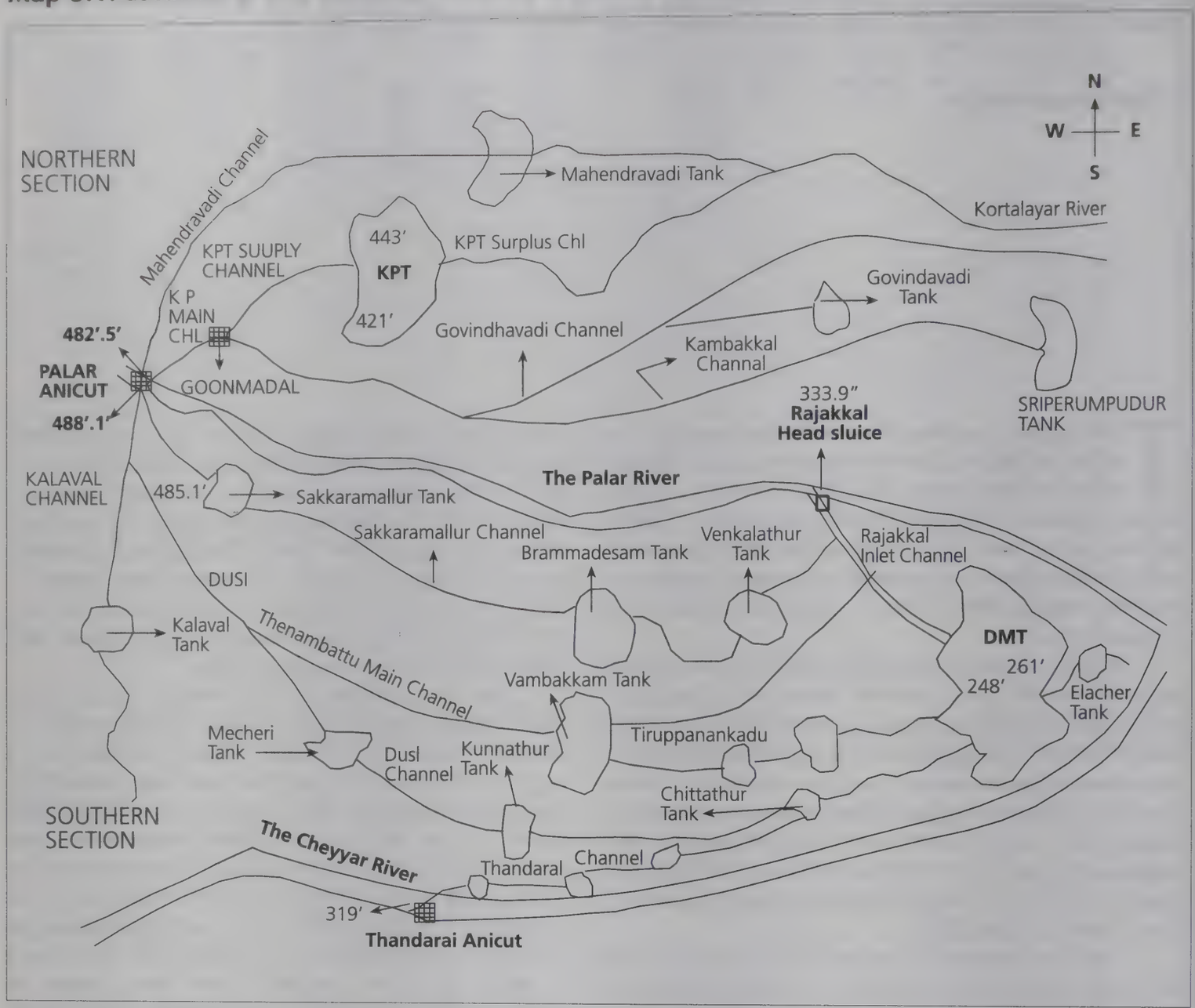
The Public Works Department regulates the volume of water released in the main channels which feed these tanks and is also in direct control of the release of water through the tanks' several sluices to irrigate their *ayacuts*. But maintenance of distribution network and water management within their *ayacuts* is left almost entirely to the user communities. Given the number of communities involved and the variability of supply to different villages under different sluices, the handling of these tasks involve far more complex institutional arrangements in the user communities than in the case of single village tanks. That both tanks are functioning suggests that the necessary institutions exist and are operational. A closer study of how these are structured and how they in fact operate is therefore of considerable interest. A comparative study of their functioning could throw useful light on how communities adapt and manage under significantly different conditions of water supply.

For this purpose, it is important first to locate these tanks, both physically and institutionally, in relation to the PAS, which largely determines the supply of water available to them and some idea of their historical evolution. This aspect forms the subject matter of first. Much of the relevant material has been obtained from archives, official reports and documents, and records of the PWD. Against this background, the manner in which maintenance of facilities is managed and water distribution is regulated, the differences in terms of water availability and their impact on productivity between different segments of the *ayacut* have been investigated through a detailed survey of the selected tanks. The findings are summarised subsequently.

THE PALAR ANICUT SYSTEM

The Palar Anicut system consists of a diversion *anicut* across the *Palar* river from which water is drawn through four main channels — two each on its north and south banks (see Map 5.1) — to feed some 317 tanks with a total *ayacut* of some 33,000 ha. Most tanks have *ayacuts* less than 400 ha (the average size being about 100 ha) and are located within a single village. Only nine tanks serve more than 400 ha each and of these, only three (including KPT & DMT) are multi-village tanks. All the tanks under PAS are several centuries old

Map 5.1: Location of KPT and DMT in the Palar Anicut System



and were integrated into the system with the construction of the *anicut* at its present site in mid-nineteenth century followed by several subsequent improvements. These improvements included the construction of an *anicut* at Thandarai and the Rajakkal channel meant to augment supplies to the tail-end tanks of the south bank (including DMT).

On an average, between 1950 and 1990, the annual quantum of water received at the *anicut* averaged around 6,000 mc. ft. Of this roughly half (about 3,000 mcft) was diverted into the distribution channels of the system. The volume so diverted accounts for less than two-fifths (36 per cent) of the total storage capacity (9,700 mcft) of all the tanks under the system. The balance is contributed by surface run-off from rainfall in the catchment. On an average, at full capacity, the storage can provide irrigation to a depth of 2.7 feet in their *ayacut*.

Both rainfall and the inflow at the *anicut* are highly variable. In 11 out of the 40 years, there was no inflow; the yield was less than 4,500 mcft. in 5 years and more than 5,000 in 13 years. The *anicut* surpluses only in 16 years. The actual water supply from PAS relative to the storage capacity also differs between the four main distribution channels. The Kaveripakkam channel draws the maximum volume (average of 2,400 mcft during 1964-1990) amounting to more than half the total capacity of the tanks served by it. By contrast the Dusi Kalavai channel (which feeds DMT) drew only 560 mcft, or barely one eighth of capacity of tanks fed by it (DMT's major supply source, apart from catchment rain, is the Rajakkal channel). PAS supply to this channel is also much more variable than for KP channel, (for details see *Sivasubramaniyan*, 1995).

PWD officials manage the system as a whole. The top management in the region where PAS is located consists of a chief engineer, three superintending engineers and three executive engineers, supported by 12 section officers spread over three districts. Their functions, as far as PAS is concerned, include maintaining the main distribution network of the system as well as *bunds* and associated structures of tanks in their jurisdiction. The section officers, assisted by work inspectors and *lascars* are expected to inspect regularly the channels and tanks in their jurisdiction, report specific repair works (together with estimates) which need to be done, and implement works approved by the higher PWD officials.

The timing and volume of water to be released from the *anicut* to various channels is determined by the officer in charge of the *anicut* according to certain general rules. For example, he is expected to operate scour vents to ensure full supply in all channels, open under-vents in the *anicut* in times of storms and take steps to erect shutters and plug leakage through scour vents after the floods recede. He is expected to operate sluices according to weekly reports received from superintendent of each main channel indicating water required and to maintain a daily account of water releases. The channel superintendent is expected to regulate water at the beginning of the season so as to give each tank in his jurisdiction about one month supply.

The basis on which weekly water requirements of different channels are determined and evaluated in the context of variable seasonal conditions, changing crop patterns and farming practices, and the use of groundwater is far from clear. A great deal of discretion seems to be left to the section officials. Moreover the capacity of the sluices and channels is no longer the same as per original specifications and the effect of sand and silt accumulation at the outlets at the *anicut* on the discharge capacity is not uniform. Altogether it is difficult to determine whether the allocation rules at the system level are sufficiently detailed and capable of determining requirements of different segments with reasonable accuracy and even more so to find out how well actual supplies are regulated in relation to requirements.

The PWD's responsibility is limited to maintenance and repair of structures and facilities of the system including tanks. In the case of KPT and DMT, the PWD has appointed tank superintendents and *lascars* to regulate impounding and release of water to the *ayacut*. Except for this, the maintenance of distribution networks and regulation of water supply within the *ayacut* of all tanks are left entirely to the farmers benefiting from the irrigation. How and how well these tasks are performed will be discussed at length later in the paper.

CONDITION OF TANKS

Water supply to KPT is derived from two sources: the volume diverted into Kaveripakkam main channel (KMC) and rainfall in its free catchment. It is second in the series of tanks fed by KMC and is situated barely 6 km from the *anicut*. The Dusi-Thennampattu (D-T) channel of PAS, a channel drawn from Thandarai anicut across the Cheyyar and another through Rajakkal channel, feeds the DMT. It is basically the last tank in the chains fed by all these channels. The D-T channel is 36 km long (feeding 36 tanks) and Thandarai 28 km (feeding 16 tanks). Only Rajakkal (13 km) is the direct source to DMT.

The KMC is lined for part of the distance to KPT but has accumulated a lot of sand; beyond the lined portion, siltation is heavy and closer to KPT it is marked by thick bush growth. In some places the *bunds* are weak or damaged, and considerable illegal pumping from the channel is taking place along the way. Encroachment, siltation and weeds, resulting in a considerable reduction in carrying capacity affect all the three inlet channels to DMT. The Rajakkal channel is in a deplorable condition. The PWD has done little to restore these channels on their original capacity.

The *bund* of KPT is overgrown with bushes and the stone work meant to strengthen the *bund* is damaged in some places. In DMT, a major repair to plug a leak in the deep sluice has substantially improved the structure. But both tankbeds are silted: the siltation at the deepest sluice in KPT being 15 feet and about 8 feet in DMT. Limited desilting has been done throughout the bottom of the tank *bund* in KPT to ensure free flow through the sluices. A detailed survey showed that the actual capacity is about 20 per cent less than original capacity. No survey has been done in DMT but being at the tail-end, siltation may not be as great as in KPT. Foreshore and tankbed cultivation is common during dry years in KPT and there is some permanent encroachment as well. The problem is not present in DMT, partly because of its rocky bed. The sluices in both tanks are fitted with tough wooden shutters and screw gears; but since the sluices are not fully shut, in order to let silt escape, there is considerable wastage of water. The surplus weirs are in reasonably good condition.

CHARACTERISTICS OF WATER SUPPLY

There are no records of the amount of water received by each of the tanks and its utilisation in different seasons. The only information available is the record of the depth of storage maintained by the PWD. In principle the

volume of water in storage corresponding to a given depth can be calculated if the configurations of the storage had been accurately surveyed. Such a survey has been recently done for KPT but not for DMT. In any case, storage tells nothing about the flows in and out. During the rainy season, the actual volume of water used is likely to be greater than the storage. But once the filling season is over (normally in December), there is hardly any inflow, and utilisation is almost exclusively based on depletion of stored water.

While these limitations preclude a detailed analysis of supply and use in the two tanks, it is possible to examine certain related issues:

(a) The relation between the quantum of water available from the main source of supply (diversion from the *anicut* and rainfall in the free catchment) and the maximum storage attained over the period of a year;

(b) The level of storage at different times of the year and its adequacy for sustaining irrigated crops in different seasons; and,

(c) The extent of variability in storage within seasons in particular years as well as in a particular season across years.

All these are of course only subject to the reliability of storage depth record, the high level of approximation of estimated yield from rainfall, and the fact that storage is not a reliable index of utilisation especially in the rainy season. As several channels, located at the tail-end of the diversion channels feed DMT and data on diversions are not available for all channels, it is particularly difficult to relate storage to supply source. In the case of KPT, there are basically two supply sources: the Kaveripakkam supply channel and rainfall in its free catchment. Being at the head of the channel, close to the *anicut*, and free catchment being equal to the combined catchment between the *anicut* and the tank, a close nexus is expected between the amount of water diverted into the channel and the rainfall in the catchment.

Table 5.1 presents the estimate of water supply in KPT channel made on the following assumptions: (1) About 50 per cent of the water diverted into Kaveripakkam main channel at the *anicut* is diverted to the KPT supply channel; (2) the yield from the rainfall in the free catchment is estimated on the basis of annual rainfall recorded at the tank site; and (3) 35 per cent of total rainfall is available in the form of surface run-off. Comparing it with actual maximum storage level recorded in KPT, it appears that:

(1) Whenever the volume diverted into the KPT supply channel increased, the maximum storage in KPT also increased. However, discharge in excess of 1,000 mcft does not make much difference to maximum storage while it reaches full tank Level (FTL). Also at very low level of flow (< 100 mcft) there is no clear relation between discharge in channel and storage at KPT.

(2) There is little association between the quantum of runoff from the free catchment of KPT and its storage level.

(3) There is a strong association between the sum of discharge into KPT storage level and run-off from the free catchment and the maximum storage in KPT *(Table 5.1)*.

Table 5.2 gives the relevant source of supply data for DMT. Relating water available from its sources and its utilisation to DMT storage is more complicated than in the case of KPT. This is owing to the following reasons: (a) records of the diversion via Rajakkal channel are not available; (b) the tank gets supply from the surpluses of tanks fed by Sakkaramallur channel; (c) the extent of combined catchment between the *anicut* and the tank is several times larger than its free catchment; (d) it is situated at the tail-end of the channel. One would, therefore, expect the relation between yield from ultimate supply sources and storage to be rather fuzzy in DMT.

The association between the volume drawn by the Dusi-Thennampattu and the Thandarai channels and the maximum storage reached in DMT is weak and statistically not significant. On the other hand, there is a strong positive association between run-off from the free catchment and maximum storage reached at DMT as well as between the sum of volume diverted by the supply channels at the source and supply from the free catchment run-off and the DMT storage. This means that the free catchment run-off is the more important determinant of supplies to DMT while in KPT it depends more on the volume diverted from the *anicut*.

RELIABILITY OF SUPPLIES

Though the maximum depth of the tanks is more or less the same, KPT attained FTL only in eight out of the 27 years (between 1964 and 1990), and DMT attained it in six. In the case of KPT the maximum storage was between 20 and 30 feet in 11 years and less than 15 feet in five years (a level at which no irrigation is considered feasible). DMT attained maximum depth of 20-30 feet in seven years and less than 15 feet in 10 years *(Table 5.3)*. In terms of full storage, KPT is clearly placed better than DMT.

However, DMT has a larger storage capacity per acre of *ayacut* than KPT and consequently if the storage is full it can irrigate for a period of 18 months compared to 14 months in the case of KPT. According to knowl-

Table 5.1: Sources of Water Supply (PAS + Catchment Run-off) to KPT

Year	MCFT		Maximum storage (feet)	Rainfall KPT (mm)	MCFT		
	KP main supply channel	KPT supply channel			Total rainfall	Run-off 35% of col 6	Total supply (3+7)
1	2	3	4	5	6	7	8
1964	6,626	3,313	30.6	723	795.6	278.5	3,591.5
1965	206	103	21.3	1,107	1,218.1	426.3	529.3
1966	1,837	918	30.6	1,144	1,258.9	440.6	1,358.6
1967	1,304	652	23.4	1,162	1,278.7	447.5	1,099.5
1968	0	0	0	392	431.4	151.0	151.0
1969	2,246	1,123	30.6	1,146	1,261.1	441.4	1,564.4
1970	1,915	958	28.7	1,192	1,311.7	459.1	1,417.1
1971	1,189	595	23.5	1,008	1,109.2	388.2	983.2
1972	3,257	1,629	30.6	969	1,066.3	373.2	2,002.2
1973	1,333	667	24.8	771	848.4	296.9	963.9
1974	3,804	1,902	30.2	829	912.2	319.3	2,221.3
1975	3,937	1,969	30.4	864	950.7	332.8	2,301.8
1976	1,488	744	29.9	1,206	1,327.1	464.5	1,208.5
1977	2,172	1,086	30.6	1,228	1,351.3	473.0	1,559.0
1978	1,650	825	29.9	955	1,050.9	367.8	1,192.8
1979	5,152	2,576	30.4	823	905.6	317.0	2,893.0
1980	0	0	0	627	690.0	241.5	241.5
1981	5,508	2,754	29.9	779	857.2	300.0	3,054.0
1982	0	0	17.0	810	891.3	312.0	312.0
1983	1,268	634	24.3	1,148	1,263.3	442.1	1,076.1
1984	1,126	563	17.2	1,332	1,465.7	513.0	1,076.0
1985	519	259	23.3	1,179	1,297.4	454.1	713.1
1986	0	0	0	724	796.7	278.8	278.8
1987	0	0	17.2	1,029	1,132.3	396.3	396.3
1988	1,646	823	29.4	1,180	1,298.5	454.5	1,277.5
1989	0	0	0	836	919.9	322.0	322.0
1990	0	0	0	681	749.4	262.3	262.3

Note: Column 2: About 50 % of the total supply from the *Kaveripakkam* (KP) main channel is diverted to KPT supply channel; Column 4: Maximum storage at the beginning of the supply season (October-December); Column 7: Excluding 65 % loss due to evaporation, percolation, encroachment on the catchment area, etc. 1 inch rainfall on 1 sq mile = 2.33 mcft of supply or 1 mm rainfall on sq mile = 0.0917 mcft could be available from the local rainfall. Free catchment area of KPT = 12 sq miles.

Source: Water reading registers of KPT and Palar anicut.

edgeable farmers, a minimum depth of 21 feet is required in KPT in order to raise at least one irrigated crop, 29 feet for two crops and 30 feet for three crops. The corresponding figures for DMT are 15, 23 and 28 feet respectively.

On the above basis and taking into account the maximum storage level reached in each year in the two tanks, we can get an approximate idea of the number of years in which their respective *ayacuts* can expect either no irrigated crop, or one, two, or three irrigated crops. In KPT out of 30 years (1961-1990) the storage in 14 years was adequate to raise three crops; in 21 years it permitted raising two crops; and in 25 years it was enough for at least a single irrigated crop. The tank remained dry in five years. During the same period, the respective feasibility for three crops, two crops and one

Table 5.2: Sources of Water Supply to DMT

Year	MCFT		Rajakkal supply	Maximum storage (feet)	Rainfall DMT (mm)	MCFT		
	Dusi channel	Thandarai channel				Total rainfall	Run–off 35% of col 7	Total supply (2+3+8)
1	2	3	4	5	6	7	8	9
1964	2,165	NA	NR	31.3	1,020	1,103.7	386.3	2,551.3
1965	9	NA	–	19.3	1,042	1,127.5	394.6	403.6
1966	855	NA	NR	30.6	1,417	1,533.3	536.6	1,391.6
1967	52	NA	–	20.3	983	1,063.7	372.3	424.3
1968	–	NA	–	–	717	775.8	271.5	271.5
1969	315	NA	NR	30.5	1,287	1,392.6	487.4	802.4
1970	103	NA	NR	23.4	1,143	1,236.8	432.9	535.9
1971	81	NA	–	16.0	1,287	1,392.6	487.4	568.4
1972	535	NA	NR	23.3	1,542	1,668.5	584.0	1,119.0
1973	9	NA	–	10.8	1,131	1,223.8	428.3	437.3
1974	578	NA	NR	16.9	887	959.8	335.9	913.9
1975	740	NA	NR	23.7	1,432	1,549.5	542.3	1,282.3
1976	541	–	NR	30.3	1,343	1,453.2	508.6	1,049.6
1977	67	953	NR	32.1	2,019	2,184.7	764.6	1,784.6
1978	307	1229	NR	24.5	1,614	1,746.4	611.3	2,147.3
1979	1,891	719	NR	31.0	982	1,062.6	371.9	2,981.9
1980	–	–	–	11.5	895	968.4	339.0	339.0
1981	1,097	151	NR	14.6	1,061	1,148.1	401.8	1,649.8
1982	–	–	–	13.0	688	744.5	260.6	260.6
1983	110	894	–	24.2	1,177	1,273.6	445.8	1,449.8
1984	4	204	–	17.3	1,006	1,088.6	381.0	589.0
1985	67	507	NR	28.0	1,205	1,303.9	456.4	1,030.4
1986	–	50	–	–	535	578.9	202.6	252.6
1987	–	142	–	12.0	755	817.0	285.9	427.9
1988	211	–	–	7.0	732	792.1	277.2	488.2
1989	–	–	–	9.0	741	801.8	280.6	280.6
1990	–	–	–	–	1,174	1,270.3	444.6	444.6

Note: Thandarai *anicut* was constructed in 1975; NA = Not applicable; NR = Data not recorded; Dash indicates no supply/storage; Column 5 indicates storage at the beginning of the supply season. Figures in column 8: excluding 65 % loss due to evaporation, percolation, encroachment in the catchment area, and so on. 1 inch rainfall on 1 sq mile = 2.33 mcft of supply or 1 mm rainfall on 1 sq mile = 0.0917 mcft could be available from the local rainfall. Free catchment area of DMT = 11.8 sq miles.

Source: Water reading registers of DMT and Palar anicut.

crop in DMT was for 12 years, 20 years, and 26 years. The tank remained dry in four out of the 30 years.

The data suggest that the position during the 1980s was different from the 1960s and the 1970s. KPT was dry only once during the 1960s and the 1970s and DMT was dry only once in the 1960s. But during the 1980s both the tanks remained dry for three years mainly because of lower rainfall than in the 1960s and 1970s. While during 1960-1980 the tanks had adequate water for three crops in four or five years out of 10, during the 1980s they were in this position only in two out of 10 years.

A more reliable — though still inadequate — basis for assessing feasibility of irrigation in different seasons would be the depth of storage at the beginning of each crop season, and the average depth of storage

Table 5.3: Frequency Distribution of Years According to Level of Maximum Storage Attained in KPT and DMT, 1964-1990

Month of max supply available		Storage levels						
		> 30′	25′–30′	20′–25′	15′–20′	1′–15′	0	Total
December:	KPT	8	5	6	3	0	5	27
	DMT	6	1	6	4	7	3	27
March:	KPT	0	12	5	4	0	6	27
	DMT	0	10	1	4	6	6	27
July:	KPT	0	0	1	12	1	13	27
	DMT	0	0	5	5	4	13	27

Source: Daily water reading registers maintained by the KPT and DMT section offices.

during each season. Three crop seasons have been distinguished: October-February, March-June and July- September. Of these the first is the rainy season and the tanks get most of their supply during this period. Storage level may be a less reliable indicator of water availability during this season; but in the second and third seasons when rainfall is low, available storage from the tank is the main source of water supply. The level of water is a crucial determinant of cropping possibilities.

The relevant data — based on a collection of daily water level recordings at the two tanks — for the period 1966-89 are presented in *(Table 5.4)*. The following features are noteworthy. In 85 per cent of the years both the tanks had storage to permit at least one irrigated crop; in three fourths of the years two or more irrigated crops could be raised. Storage by July which is used for cropping in the third season is available more frequently (13 out of 24) in DMT than in KPT (11 out of 24).

Inferences about the feasibility of irrigated cropping based on level of tank storage alone are subject to qualifications for at least three reasons: (a) The level of storage at the beginning of a season only indicates whether or not any tank water is available for irrigation in that season. In general, given that the depth of water level declines after October-December, the extent of the *ayacut*, which can be irrigated by the tank in the third and first seasons, will be smaller than in the second. The extent of area, which can be irrigated in a season, varies depending on the level of storage in that season. (b) The feasibility of cropping depends also on the extent and distribution of rainfall in each season. This is especially important in the first and the third seasons. And (c) as groundwater exploitation is significant in the *ayacut;* the extent of cropping in the second and third seasons will be determined by the quantum of groundwater pumped. Considerable changes have occurred in this respect as a result of growing tendency for conjunctive use of surface and groundwater. The extent of such development differs significantly between KPT and DMT, and also within the *ayacut* of each of these tanks.

MANAGEMENT OF TANKS

Tank-level Organisation

After the *anicut* was constructed the PWD took direct responsibility for managing the system as a whole, and the tanks themselves were managed jointly by the PWD, the Revenue Department and the local village authorities, each with well defined functions and responsibilities. The village *ayacutdars* and the revenue department were responsible for *kudimaramath* and for the smooth distribution of water. The regulation of tank water to the *ayacut* was governed by certain procedures. According to these procedures, during the irrigation season, the *maniagar* in each village under the tank *ayacut* should send to the tank superintendent — a PWD official — two statements every month; one on 15th indicating the area actually under irrigation and another on 25th indicating the amount of water required during the first half of the next month. Copies of these statements were also to be sent to the *tehsildar*. The *maniagar* reported to the superintendent and the *tehsildar* any fluctuations of water supply in the areas under their control due to heavy rain in the *ayacut* necessitating modification in quantity of water to be released by the superintendent at any time. The

Table 5.4: Availability of Water Supply in Different Crop Periods in KPT and DMT, 1966-1989

Period	No Crop	1 Crop	2 Crops	3 Crops	Total
KPT					
1966-1979	1	0	5	8	14
1980-1989	2	2	3	3	10
1966-1989	3	2	8	11	24
DMT					
1966-1979	1	1	2	10	14
1980-1989	2	3	2	3	10
1966-1989	3	4	4	13	24

Note: If the tank supplied water adequately to the third crop, one could definitely say that the second crop also got adequate supply because the maximum storage in the tank is reached by December. After that the tanks would not get any supply. Three crops total does not include one crop and two crops total.

Source: Daily water reading registers of KPT and DMT.

discharges at the main tank sluices were to be regulated by the superintendent according to the needs of the *ayacutdars* through requests made to the *maniagar* and reported to him to increase or reduce the quantum of supply released from the tank.

For reasons which are not clear — available archival information is meager — the government decided in 1917 to vest the responsibility for management of these 2 tanks with Boards comprising elected representatives of the *ayacutdars*. Under this new arrangement, riots owning or cultivating lands under the tank or their nominees were to elect delegates from whom the *panchayatdars* to serve the Board were also elected. The revenue divisional officer was expected to convene a meeting of the delegates representing various villages under the *ayacut*, electing not less than five persons from among them to serve as *panchayatdars*. The election was to be held once in three years. The president and the secretary of each irrigation board (IB) were to be chosen by its elected *panchayatdars*. Copies of the minutes of the meetings were to be sent to the collector and the executive engineer for information. The collector was empowered to dissolve the board without giving any reason.

For proper distribution of water within the *ayacut*, control over operation of sluices and regulation of channel flows was given to the board with certain conditions. The board decided the time for commencing the supply of water, as well as duration and the quantity to be supplied. The government sanctioned an annual grant for the up-keep of the inlet channels, which the Board utilised under the supervision of the PWD officials. The PWD attended to the clearance of silt and ordinary repairs.

The rules and regulations for the constitution of IBs came into force in 1917. But formation of IBs was not compulsory, and they were constituted in only some tanks including KPT and DMT. The board for KPT was constituted in 1923 and elections held regularly till 1969. At that time, the KPT board had 24 delegates. Every village in the command was represented. The number of delegates per village varied from one to five. The large majority of them were drawn from the dominant land owning castes — Nayakars and Mudaliars. No election has been held since but the board has not been formally disbanded.

Of the 24 members elected in 1969, 10 have died. The remaining 14 (including the president and the secretary) continue to take active interest in the tank management and observe conventional rules and procedures. Though the secretary does not have much land in the *ayacut*, he is widely respected for his knowledge and experience in water management. His leadership is accepted. It is also noteworthy that most of the delegates are from *nattanmaikar* families who have an important role in managing village affairs.

An irrigation board for DMT was also constituted in 1917. It seems to have worked satisfactorily till the sixties. The latest election was conducted in 1969. Thereafter, frequent squabbles among members who were involved in political parties and their factions and inefficient functioning of the board under the last elected president is reported to have seriously impeded its functioning. In this context the *ayacutdars* themselves set up an informal organisation in 1975 and elected respected and knowledgeable persons from different *ayacut* villages to apprise the officials of their problems and secure redress. This Dusi-Mamandur Hissa Tank Farmers' Association gradually became stronger and, in September 1980, was formally registered under the Societies Registration Act. It has effectively taken over the functions of the IB, which, though not formally dissolved, has become practically defunct.

Fiftyseven elected delegates manage the DM farmers' association; every village is represented. Inspite of not being officially recognised and though its efforts to lobby the government for various improvements have not been successful, this association has practically replaced the IB in the management of DMT.

The main functions of the KPT irrigation board and the DMT farmers association are to: (i) enforce the rules and regulations to maintain and distribute water during normal and lean supply periods; (ii) solve major problems in the system collectively; (iii) hold meetings with all the representatives once a month to discuss the irrigation matters and other activities; and (iv) distribute tank supply fairly among the *ayacutdars* located in different reaches of the villages. The DMT farmers' association has been active in seeking to augment water supplies from all the sources. In particular it mobilises community labour to form mud *kondam* (temporary earthen weir) to divert floods in the Palar through the Rajakkal channel — its most dependable source of supply.

One of the important functions of tank level organisation in both the tanks is to regulate the release of water from the tank to the *ayacut* villages. This continues to be done in accordance with long standing custom: The representative of the particular village makes a request to the secretary of the IB/farmers' association by giving *yadas* (written slips) stating the amount of water (in terms of sluice screws to be raised or lowered) to be released in the channel. In KPT the responsibility of releasing the required quantity of water is vested with the secretary of the IB, whereas in DMT it is shared by a group of six members of the farmers' association. In DMT, during the supply period, the association holds regular meetings to decide

on maintenance of the main outlet channels, quantity of water to be released in each channel and other related matters. The type of crops to be grown by *ayacutdars* will is decided by farmers themselves; neither the PWD nor the IB interferes in it. Sometimes the DMT farmers' association settles some inter–village disputes.

When the IBs were set up, the government appointed *neerkatties* (four for KPT, two for DMT) to help the board to perform several activities such as watching the inlet and main outlet channels, report immediately to the board about channel breaches for taking necessary action through the PWD; protect the *bunds* from cattle during the supply season; report encroachments, if any, in the channels; prevent tampering with the sluices; and watching the channels during the lean periods of supply to prevent illegal tapping and so on. However, they are not expected to irrigate the fields. In 1992 they were paid a consolidated salary of Rs 612 per month by the government. Since the IB of KPT is not active and DMT farmers' association is an informal one, it is reported that the functioning of *neerkatties* appointed by the government are unsatisfactory. At present, mostly officials of the revenue department utilise their services.

Village-level Organisation

The village-level organisation is responsible for various tasks of irrigation management below the tank sluices. These include diverting water through the inlet channels, organizing the *ayacutdars* for maintenance of channels, and allocating water among the *ayacutdars* both during normal and lean supply periods.

Scrutiny of the *Mamulnamas*[1] indicates that traditionally, each village had a well-articulated organisation for managing maintenance and water allocation. In the early nineteenth century, the organisation consisted of a headman (*nattanmaikar*), *kavaimaniyam* (person responsible for maintenance of channels) specialised in tank management, an accountant and a *munsiff* as first tier, and below it the *thotti, kammukutti, talaiyari* and the head fisherman to perform irrigation tasks in the field. But very little is known about the details of the actual functioning of the organisation in the past.

According to villagers some four to five decades back the irrigation institutions at the tank and village levels functioned actively and in an organized manner. In the past land was concentrated in a relatively small and homogeneous group of upper castes whose economic power reinforced their superior status in the social hierarchy. The leadership and center of power in the villages were with *mattanmaikars* who were invariably from the upper castes. The *kavaimaniyams* were also from the upper castes. They commanded the authority and the power to ensure that the rules regarding management of tank water were effectively enforced. Since then there have been far reaching changes in the land ownership pattern in both the tank *ayacuts*. Diminishing storage capacity of tanks due to silting, encroachment in the channels, deficient supply from the source for a long time, growing value of water due to changes in agricultural technology, and increasing private ownership of wells in the *ayacut* are other factors which have affected the management of the tanks. As a result, the functioning of these institutions is reported to have gradually weakened. Their working at present is not considered satisfactory.

Land Control and its Transformation

The population of the villages served by both the tanks has increased over the years. The population of KPT villages has more than doubled between 1881 and 1981, and that of DMT villages has increased by 150 per cent *(Table 5.5)*. The available land being more or less fixed, there has been a progressive subdivision of holdings, and a steady increase in the number of *ayacutdars*. The total number of subdivisions in the KPT villages has more than doubled, and that in DMT has increased by 66 per cent between 1882 and 1983. The total number of *Pattadars* (including both wet and dry lands) has increased about five folds in KPT and nearly quadrupled in DMT. With increasing number of plots and farmers to be served by tank water, the potential for conflicts and the difficulties of mobilizing people for maintenance, and enforcing allocation rules have also

Table 5.5: Population, *Ayacut*, *Ayacut* Subdivisions and *Pattadars* in KPT and DMT, 1881–1983

Name of tank	Population		*Ayacut* (hectares)		*Ayacut* subdivisions		Total *Pattadars*	
	1881	1981	1982	1983	1882	1983	1882	1983
KPT	16,075	33,042	2,590	2,370	6,085	12,266	2,131	10,286
DMT	7,534	18,775	1,667	1,676	8,638	14,378	1,573	6,277

Source: Census registers 1881 and 1981; Settlement (1882) and Updated settlement (1983) registers.

increased, often more than proportionately.

The social composition of land owning groups has changed dramatically: Thus in KPT in 1882, the *mudaliars* controlled the largest proportion of land in 13 out of 14 villages and in the remaining one village Brahmins were dominant. The Reddies and Pillais owned only 6 per cent of the total holdings. The Nayakars, who were far more numerous, owned about 12 per cent and they were not dominant in any of the KPT villages *(Table 5.6)*.

By 1983 this pattern changed dramatically: the share of Mudaliars in the tank *ayacut* declined by more than half and that of Brahmins from 10 per cent to a mere 2.5 per cent. Land ownership by Brahmins is not significant in any village. The Mudaliars, however, own about 30 per cent of the *ayacut* and have retained their dominance in six villages (one in the head, one in the middle and 4 in the tail-reach). Other upper castes (Reddies and Pillais) improved their share from about six per cent in 1882 to 13 per cent in 1983; but they are not dominant in most of the villages. Over the years the Nayakars, who were earlier mostly tenants of the upper-castes, have acquired greater control over land and now own 31 per cent of the *ayacut*. They are dominant owners in 3 of the head and one middle reach villages. Significantly, Scheduled Caste *pattadars* have also acquired a sizable proportion of land — their share in total *ayacut* rising from a mere 1.3 per cent in 1882 to over 10 per cent in 1983. They now rank third in the overall possession of land holdings among the different castes (for details on caste-wise distribution of land holdings in the *ayacut* villages under KPT and DMT, see Sivasubramaniyan, 1995).

In the DMT villages the shift in land ownership from upper castes to the lower castes is even more pronounced. In 1882 Brahmins and Mudaliars owned more than four-fifths of the total *ayacut*; and Nayakars and Scheduled Castes owned very little land. However, during 1983, Nayakars emerged as the most significant land owning group controlling over a half of the total *ayacut* (11 out of 18 villages). In recent years the Scheduled Castes have also acquired considerable portion of land, whose share has gone up from 1 per cent to 7.5 per cent in the tank *ayacut*.

The changes in caste-class and land holding structure have affected the working of institutions. Though the upper caste landholders are present even now in a few villages under both the tanks, their position as landowners as well as their authority in the community has declined. With the diffusion of land ownership, the passing of land control to lower castes with larger and rapidly growing populations and the increasing involvement and influence of officials, functionaries and leaders of political parties and other outsiders in village affairs, the ability of the village leaders to coordinate and to enforce rules on maintenance and water distribution has weakened. One could expect local institutions to be stronger in villages where land is concentrated in a single caste than those where ownership is diffused among several castes. When different villages under a tank have two or more dominant castes, the problem gets compounded. Actually, the latter is the case in several of the villages studied under both the tanks.

The Growing Demand for Water

The growing demand for water in agriculture is mainly due to 3 factors: (i) increased use of HYV seeds and chemical fertilisers; (ii) changes in cropping pattern and (iii) introduction of multiple cropping. Before the 1960s farmers mainly raised crops using local seed varieties which did not require high standards of water management. Paddy, the main water intensive crop in the region, was grown mainly in the rainy season. In other seasons dry crops were grown. Though the *ayacut* of both tanks had a sizable number of wells even in 1913, there being no energised pumps, the area irrigated by them must have been relatively small *(see Table 5.7)*.

This situation has changed drastically in the last 2-3 decades, with the substitution of local varieties by High Yielding Varieties and seasonal crops with annual crops; increased use of fertilisers, and introduction of multiple cropping. These changes have led to higher demand for water and made control over timing and

Table 5.6: Caste-wise Percentage Distribution of Land Holdings by Pattadars in KPT and DMT, 1882 and 1983

Tank	*Ayacut* (hecs.)		Caste-wise distribution of land holdings, 1882							Caste-wise distribution of land holdings, 1983						
	1882	1983	MR	Nayakar	Brahmin	Reddy	Pillai	SCs	Others	MR	Nayakar	Brahmin	Reddy	Pillai	SCs	Others
KPT	2,589.9	2,369.6	63.9	12.5	9.9	2.8	2.7	1.3	7.0	30.5	31.3	2.5	7.7	5.6	10.5	12.0
DMT	1,667.2	1,675.7	38.7	3.2	45.6	0.0	2.3	1.1	6.6	22.2	51.0	6.7	0.0	4.0	7.5	8.6

Note: MR = Mudaliar; SCs = Scheduled Castes; Others include Carpenter, Blacksmith, Glodsmith, Potter, Pandaram, Dhobi, Panditha r, Karnam, Fishermen, Panchangam, Talaiyari, Manyam and Temple lands, Udaiyar, Chettiar, Naidu, Muslim and Unidentified.

Source: Settlement (1882) and Updated settlement (1983) registers of KPT and DMT villages.

Table 5.7: Crop Pattern and Well Density in KPT and DMT, 1913 and 1983

Name of the tank	Crop pattern: % of area under crops								Wells/100 hectares	
	1913				1983					
	Paddy	Banana & S cane	Oil seeds	Others	Paddy	Banana & S cane	Oil seeds	Others	1913	1983
KPT	67	2	11	20	65	21	8	6	15	31
DMT	73	0	19	8	61	1	33	5	20	36

Source: Resettlement (1913) and Updated Settlement (1983) registers of KPT and DMT villages.

volume of irrigation crucial. Increase in cropping intensity and switch over to annual crops is marked in KPT, but not in DMT. As available supply from the common sources has not increased — if anything the neglect of system maintenance may have reduced supplies — there is greater potential for conflicts over water allocation.

Spread of Conjunctive Use

To some degree this has been taken care of by expansion of wells in both the tank *ayacuts*. The number of wells in 1983 is nearly double that in 1913 in KPT, about 75-80 per cent more in DMT. Moreover, most of the wells are now energized. Consequently, the volume of water pumped and area under conjunctive use must have increased much more than two fold. But this process of well development has affected the working of institutions for tank management. At present there are 734 wells in the KPT *ayacut* and 608 under DMT. *(see Table 5.8)* Though the average density of wells is higher in DMT, the KPT wells seem to have more abundant supplies and therefore may have a longer proportion of its *ayacut* benefiting from conjunctive use. Well densities within the *ayacut* very greatly: one of the KPT villages have wells while at the other extreme three have more than 50 per 100 hectares. In DMT, the density varies from 5 to 217 per 100 ha.

Those who own wells are dependent less on tanks and if they get adequate supplies from their wells their interest in tank management weakens. The larger and the more widespread conjunctive use, the weaker is likely to be participation in collective activity related to tanks. The fact that crop patterns in DMT have not shifted in favour of water intense annual crops and that, if anything, the proportion of irrigated dry crops has increased substantially suggests that, despite increase in conjunctive use, water supply conditions may have, if anything worsened. This is not implausible given evidence of deterioration in inlet channels and siltation of tankbed, both of which would reduce tank water supply as well as seepage available for pumping in the tail-end. The situation in KPT presents a marked contrast. It seems likely that this conjunctive would weaken incentives for collective action in management of KPT, much more than in DMT. An expectation which is consistent with the fact that the DMT farmers' reaction to malfunctioning of the Board has been pro-active and that they have nearly twice the number of *neerkatties/thotties* per hectare of *ayacut* compared to KPT.

At present the delegates to the IB (who also happen to be influential *Nattanmaikars*) play a key role in KPT villages. Three of them have *Kavaimaniyam* specifically to handle tank-related matters within the village. In DMT, the delegate to the DM Hissa Tank farmers association — again drawn from influential landowners — perform this function. In both cases the village level functionaries assist them. Three have *Kavaimaniyams* specifically to attend to tank matters within the village. All have *Kammukutties* and *Thotties* to help organize channel maintenance, construct *Kondams* and implement rationing within the village *ayacut*.

These workers are paid by the *ayacutdars* at rates determined by custom. At present KPT villages have 35 workers in this category and DMT 30 workers. Relative to *ayacut*, DMT has many more of these functionaries. All KPT villages, and 13 of the 18 DMT villages, report having them. But the density shows wide variations

Table 5.8: Well Density under Villages Grouped by Sluices in KPT and DMT, 1989

Tank	Level of sluices	No of villages	*Ayacut* (ha)	No of wells	Well density wells/100 ha
KPT	Deep	3	1,019	246	24
	Middle	8	1,258	437	35
	Elevated	3	93	51	55
	KPT as a whole	14	2,370	734	31
DMT	Dusi sluices	9	758	156	21
	Mamandur sluices	9	918	452	49
	DMT as a whole	18	1,676	608	36

Source: Adangal Registers (1989) of the KPT and DMT villages.

between villages. Our detailed survey of a sample of farmers on selected villages shows that in a normal year actual payments to these workers ranged from 0 to Rs 35 per ha on KPT and Rs 60 to 120 per ha in DMT.

On the whole, judging from the responses of village level interviews, maintenance, the number of functionaries and institutions are more active in DMT than in KPT. Our sample survey of farmers in some of the villages sought these assessments of the functioning of the institutions. Except in the head reach villages of KPT, most farmers' felt that the PWD's either did not function or functioning was unsatisfactory. A majority of farmers in the KPT villages — again except in the head reach — thought the Irrigation Board to be non-functional or unsatisfactory. But in contrast the large majority of DMT farmers rated the Association's functioning was good. The DMT farmers also rate the functioning of village organisation as good for more frequently than the KPT counterparts.

SURVEY OF SELECTED VILLAGES

The foregoing account gives a broad overview of the functioning of KPT and DMT. It is necessarily sketchy and incomplete. it does not tell us enough about the adequacy and reliability of tank supplies, extent of access to groundwater and the impact on productivity in different segments. Nor does it tell us much about the extent to which farmers participate in collective activity for maintenance and allocation. For this purpose a special survey of sample of farms in selected villages under each tank was conducted in 1992.

Conditions of water supply (determined by elevation of sluice, location relative to its head and availability of wells) have a significant bearing on incentives for community management, even as the caste composition is likely to influence its effectiveness. Keeping these considerations in view, we selected five villages under KPT: one each from the head and the tail-end of the deepest and the elevated sluices, and one from the tail-end of the middle sluice. The villages chosen were served only by one sluice and had a single dominant landowning caste. In DMT four villages were chosen: two each from the head and tail-end of the Dusi and the Mamandur sluices.

Personal visits to inspect the supply and distribution networks together with interviews with knowledgeable people in selected villages, show that main channels bringing water to the village are encroached in most cases and the branch canals to a lesser extent in some of the villages. Supply in the main channel is reportedly reduced. Its effect is felt more by tail-end villages. Three of the four DMT villages have no field channels; while four of the five KPT villages do. None of the villages with field channels report any serious problems. Maintenance of the distribution network is done regularly when supplies are available. During the decade prior to the survey, maintenance was reported to have been done three to 20 times, the majority for less than six times. It must be noted however that the 1980's were marked by exceptionally high frequency of below normal rainfall, and consequently most of the survey tanks did not get water for five or more years during this period. When storage is inadequate, and the chances of getting water are low, interest in maintenance weakens especially in the tail-end. There are well recognized and accepted practices regarding the contributions expected from the *ayacutdars*, the organisation of work, and penalties for non-compliance.

FARM–LEVEL SURVEY

In order to get a better picture of the actual situation on the ground (in terms of collective effort in repair and maintenance, the availability of water and method of regulating its distribution) in different segments of the *ayacut*, a detailed farm level survey of (210) selected farmers was conducted in nine selected villages[2].

In each village *ayacutdars* were divided into three categories. Those who have wells in their *ayacut* land; and non-well farmers with a major part of their land in the head reach and in the tail segments of the *ayacut* land in the village. Eight farmers from each category were selected randomly. They were asked to provide information on their household characteristics; land use, cropping, input use and yield; their participation in maintenance of channels; assessment of water supply conditions and the observance of rationing in times of scarcity. These data were obtained for both the tanks for the agricultural year 1991-92 just preceding the time of survey and for 1989-90 in the case of KPT. DMT villages did not get any tank water during 1989-1991.

Participation in Maintenance

A summary account of the labour participation in maintenance obtained from the sample farmers is presented in *Tables 5.9 and 5.10*. These Tables show striking differences in labour participation in maintenance between KPT and DMT.

In KPT no farmer reported involvement in maintenance of inlet channel: This was left wholly to the PWD. But in DMT, although the PWD is responsible for maintenance of all the inlet channels, the diversion of the Palar river floods into DMT through the Rajakkal sluice is routinely done by the *ayacutdars* themselves by construct-

ing *korambus* during every supply year. Occasionally, the maintenance of Rajakkal head sluice and de-silting of the Rajakkal channel are done by the PWD.

In KPT in 1991-92, the proportion of sample farmers in most villages, and most categories, participating in maintenance of main/branch channels was very high (75 per cent). Tail-end villages contributed more to main/branch channel maintenance than the head-reach villages. Generally participation in maintenance of field channels was higher than in main/branch channels. In most cases, the proportion of sample well farmers participating in main/branch channels maintenance was not very different from non-well farmers, but the frequency of their participation was lower than non-well farmers. Well-owning farmers also tend to contribute more in cash for hiring labour. Within each village non-well farmers in the tail segment contributed somewhat more to the tank than those in the head segment of the villages.

Participation in maintenance of field channels varies considerably between tanks and across villages within the tank. Most of the sample farmers in Kattalai did not participate in this activity. Participation was also low in Kadaperi. The high degree of non-participation in these two villages was said to be due to the non-existence of field channels and widespread practice of field-to-field irrigation.

In other villages participation was widespread and in a majority of cases maintenance was done two or three times during the year. The work was exclusively done by the farmers' own labour and no hired labour was reported in any of the sample villages. The number of mandays spent for field channel maintenance ranged from one to 21, this being the highest in the tail-end village of Alapakkam. Invariably, in all the villages well farmers contributed more labour than the non-well farmers, and non-well farmers in the tail-end contributed more than their counterparts in the head reach. In all cases, well farmers contributed more to field channel maintenance than non-well owners, and among the latter, those in the tail segments.

The imputed cash value of the total contribution for maintenance per hectare of *ayacut* is the highest in Panniyur (Rs 142), served by the elevated sluice followed by the tail-end villages of Alapakkam (Rs 136) and Athipattu (Rs 131). It is lowest (Rs 34) in Kattalai which being at the head of the deepest sluice is best placed in terms of water supply. Well farmers contributed much less per hectare than the non-well farmers in all the villages. Among non-well farmers — except in Kadaperi and Panniyur — the head reaches contributed less per hectare of *ayacut* than the tail-reach farmers. With an exception, proportion of total contribution going to field channel maintenance is markedly higher among well farmers compared to non-well farmers, and among the latter, this proportion tends to be somewhat higher among the tail-reaches than the head.

During 1988-89, the nearest preceding year in which KPT got water, the tank did not surplus. Under conditions of insufficient supply farmers contribution to channels maintenance (ranging from Rs 37 to Rs 87 per ha) was considerably smaller than in 1991-92 — a normal year. The contributions were mostly in the form of own labour; and the pattern of variation between well and non-well farmers and between head and tail-reach tanks were also similar to that reported in 1991-92. Significantly, however, under conditions of inadequate supply, *ayacutdars* contributed relatively more labour for field channel maintenance than in main/branch channels. This was to ensure that the available scarce supply was utilised properly through the field channels to reduce water waste by flooding.

In DMT there was no supply available to any of the sample villages since 1985-86. Hence we could collect data only for the latest supply year (1991-92). In this year, except Sothiyampakkam, all the remaining sample villages participated in the construction of *korambus* to divert the Palar water to DMT. The contribution of labour was relatively more in the villages served by Dusi sluices than the villages under Mamandur sluices. Dusi deep sluice being three feet above the sill of the Mamandur deep sluice it has a strong interest in ensuring sufficient diversion via Rajakkal.

Unless DMT gets enough storage the villages under Dusi sluices will not get adequate water supply even in a normal year like 1991-92. Therefore, both head and tail-reach villagers of these sluices contributed labour for diversion work. As evident from *Table 5.10*, under Dusi sluices about 50 per cent of the sample farmers in Vagai and Punaithangal villages contributed labour. Farmers in Narasamangalam, at the head of *mamandur* sluices, also participated though to a lesser extent than in Dusi sluice villages, in the construction of *korambu* work. But in Sothiyampakkam, which gets supply only when the tank receives more than 25 feet storage, none of the sample farmers contributed labour to the diversion work.

In Punaithangal, contribution of hired labour was more than own labour. This is mainly because Mudaliars, who control most of the land, send their tenants for the maintenance work. No cash contribution for *korambu* work was reported in any of the villages. Since the floods in the Palar last for about a week or two, the diversion work needs to be done as quickly as possible, and most of the *ayacutdars* participate in this activity. Between well and non-well farmers, participation by the former is more than the latter. Probably

Table 5.9: Labour and Cash Contribution for Maintenance of Channels by Sample Households in KP

Sample villages	Sample HHs by type	Extent of holdings		Main/branch channels							
				No. of farmers participated				Labour		Total	Cash only
		Sample	Total (ha)	0	1	2	3	Own	Hired		
1	2	3	4	5	6	7	8	9	10	11	12
Kadaperi	Well 8	7.6	9.7	6	2			2	0	2	100
E (H)	Head 8	4.7	9.3	3	4		1	5	2	7	0
	Tail 8	3.6	8.6	2	3	2	1	10	0	10	60
	Total	15.9	27.6								
Panniyur	Well 8	4.9	6.9			8		16	0	16	14
E (H)	Head 8	2.2	14.3	1	2	4	1	13	0	13	50
	Tail 8	1.5	8.6		3	5		13	0	13	0
	Total	8.6	29.8								
Kattalai	Well 8	10.8	43.5	2	6			4	2	6	0
D (H)	Head 8	3.2	52.5	2	3	3		5	4	9	0
	Tail 8	3.5	36.9	3	2	3		6	2	8	0
	Total	17.4	132.9								
Allapakkam	Well 8	15.6	22.1		3	4	1	4	10	14	50
M (T)	Head 8	2.3	28.1		1	6	1	16	0	16	10
	Tail 8	7.2	36.5		1	3	4	14	5	19	0
	Total	25.1	86.7								
Athipattu	Well 8	9.0	59.6	2	2	3	1	7	4	11	100
D (T)	Head 8	1.9	23.9	1	2	5		12	0	12	0
	Tail 8	2.6	30.9	2		5	1	13	0	13	0
	Total	**13.4**	**114.3**								

Note: In KPT the inlet channel maintenance has been fully undertaken by the PWD since 1858. Before the construction of Palar *anicut* (1858), the diversion of water from the and the maintenance of the inlet channel was mainly undertaken by the *ayacutdars* themselves. The Table is derived on the basis of weighted averages of the total land ings of *ayacutdars* in each type of farmer groups; 0, 1, 2, and 3 as indicated in the Heading refers to the number of times the respondents participated in the mainte activity; E (H) = Elevated sluice head reach village; D (H) = Deep sluice head reach village; M (T) = Middle sluice tail-reach village; D (T) = Deep sluice tail-reach v Prevailed wage rate per manday in 1991-92 was: Kadaperi Rs 15; Panniyur Rs 10; Kattalai Rs 15; Alapakkam Rs 20; and Athpattu Rs 20.

Source: Field survey data, 1992.

because recharge of DMT wells depends critically on the tank supply.

For main/branch channels maintenance, all sample farmers in Vagai and Sothiyampakkam villages *(see Table 5.10)* reported labour contribution. In Punaithangal a part of the *ayacut* served by the *mamandur* sluices did not get supply for more than ten years. As a result, the farmers did not participate fully. The well farmers in this village sent only hired labourers. In Narasamangalam, situated adjacent to the tank, most of the farmers did not participate.

In Sothiyampakkam, where the village level organisation is strong, practically all *ayacutdars* contributed labour. Those who did not, were fined. During the year of survey a total of Rs 265 was collected as fines in this village. In Vagai, though situated at the head, farmers actively participated in channel maintenance not so much to get proper tank supply but to prevent the water logging/drainage problem. Whenever water is released from the tank it seeps through the channels and makes the *ayacut* waterlogged. Hence, all the farmers are alert in keeping the main/branch channels clean for free flow of water.

Labour participation for field channel maintenance was very limited in DMT. This is mainly due to non-existence of field channels, especially in Vagai and Punaithangal villages. In the remaining two villages, Sothiyampakkam contributed more labour than Narasamangalam. Within each village well farmers' share was the highest. In the tank as a whole, cash

91-92

(Cash in Rupees; Labour in Mandays)

Field channels				Total contribution				Imputed value		Contribution for Main/ Branch channels only	Imputed value	
of farmers participated			Own Labour	Labour only (11+17)	Converted into cash	by sample farmers (19+12)	% of labour contribution (19/20) X100	for all farmers in the *ayacut* (20/3)X4	Per hectares (22/4)		for all farmers in the *ayacut* (24/3)X4	Per ha (25/4)
1	2	3										
14	15	16	17	18	19	20	21	22	23	24	25	26
2	1	2	10	12	180	280	64	357	36.7	130	166	17.0
2	2		6	13	195	195	100	387	41.7	105	208	22.5
	3	1	9	19	285	345	83	818	95.4	210	498	58.1
								1,562	56.6		872	31.6
	5	3	19	35	350	498	70	708	102.1	308	438	63.1
	3	2	12	25	250	300	83	1,981	138.2	180	1,189	82.9
1	4	2	15	28	280	280	100	1,553	181.5	130	721	84.3
								4,243	142.2		2,348	78.7
3			3	9	135	135	100	546	12.5	90	364	8.4
1			1	10	150	150	100	2,485	47.3	135	2,237	42.6
1			1	9	135	135	100	1,443	39.1	120	1,282	34.7
								4,473	33.7		3,883	29.2
	3	5	21	35	700	750	93	1,063	48.1	330	468	21.1
1	6		13	29	580	590	98	7,059	251.3	330	3,948	140.5
1	5	2	17	36	720	720	100	3,668	100.5	380	1,936	53.1
								11,790	136.0		6,352	73.3
	2	3	13	24	480	580	83	3,841	64.5	320	2,119	35.6
4	2		8	20	400	400	100	5,048	211.6	240	3,029	126.9
	3	2	12	25	500	500	100	6,031	195.1	260	3,136	101.5
								14,921	**130.5**		**8,284**	**72.5**

contribution for channel maintenance was not reported in any of the villages (except for the fine collection in Sothiyampakkam).

The imputed value per hectare of labour contribution indicates that *ayacutdar* in Punaithangal contributed the highest amount (Rs 81) among all the villages and the least (Rs 54) in Narasamangalam. The level of contributions in DMT is substantially less than in KPT; also the proportion devoted to main and branch channel maintenance is higher. Within each village, well farmers contributed less than that of non-well farmers. Among the latter, those in the tail segment contributed substantially less than those in the head segment. A larger proportion of the former went into maintaining main and branch channels.

The foregoing account shows that *ayacutdars* of surveyed villages of both tanks actively participate in maintenance of channels mainly by contributing labour. The extent of contribution is sizable — ranging from Rs 34 to Rs 130 per ha in KPT during 1991-92, a normal year, and Rs 54-82 in DMT. The variations bear a systematic relation to the need for maintenance to secure supplies for particular segments and access to well water. Maintenance is more intense and participation more widespread in good year than years of inadequate supply; the tail-end villages participate and contribute more than those located at the head of the distribution network; those with wells invariably contribute less than those without. Participation is weak when the effort at maintenance is unlikely to make a

Table 5.10: Labour and Cash Contribution for Maintenance of Channels by Sample Households in DM

Name of sample villages	Sample HHs by type	Extent of holdings		Water diversion					Main/branch channels								Cas oni Rs
				No of farmers participated		Labour		Total	No of farmers participated					Labour		Total	
		Sample	Total			Own	Hired							Own	Hired		
		Hectares		0	1				0	1	2	3	4				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Vagai	Well 2	4.8	4.8		2	2	0	2		1	1			1	2	3	0
E (H)	Head 8	1.9	9.8	5	3	3	0	3		6	2			10	0	10	0
	Tail 8	5.3	11.3	3	5	5	0	5		0	5	3		11	0	11	0
	Total	12.0	25.9														
Punai-	Well 8	8.3	28.7	5	3	0	3	3	3			2	3	0	18	18	0
thangal	Head 8	2.9	22.2	3	5	2	3	5			4	3	1	10	11	21	0
E (T)	Tail 8	3.3	7.4	6	2	1	1	2	5			3		9	0	9	0
	Total		14.5	58.3													
Narasa-	Well 8	6.3	13.0	4	4	4	0	4	4	3	1			5	0	5	0
mangalam	Head 8	4.4	16.8	4	4	4	0	4	3	2	3			8	0	8	0
D (H)	Tail 8	2.3	14.7	7	1	1	0	1	1	7				7	0	7	0
	Total		13.0	44.6													
Sothiyam-	Well 8	10.3	29.0	8		0	0	0	1		1	4	2	22	0	22	180
pakkam	Head 8	3.6	15.3	8		0	0	0				7	1	17	8	25	30
D (T)	Tail 8	5.3	9.5	8		0	0	0			1	6	1	24	0	24	55
	Total		**19.2**	**53.9**													

Note: In Dusi-Mamandur tank the *ayacutdars* diverting the Palar river floods during north-east monsoon period through the (main) inlet channel called Rajakkal in every su year. This work has been routinely followed by the *ayacutdars,* but the PWD has not effectively done this job till now. In 1989-90, Dusi-Mamandur tank supply (11 feet d was not available for cultivation in any of the above four sample villages, hence no maintenance work was undertaken by the *ayacutdars;* For field channel maintenanc cash contribution is reported in any of the villages. In Sothiyampakkam village the cash amount represents the fines collected from the defaulters apart from their own lab contribution. The Table is derived on the basis of weighted averages in each type of farmer groups; 0, 1, 2, 3 and 4 as indicated in the heading of the Table refers to number of times the respondents participated in the maintenance activity; E (H) = Elevated sluice head reach village; E (T) = Elevated sluice tail-reach village; D (H) = D sluice head-reach village Prevailed wage rate per manday in 1991-92: Vagai Rs 15; Punaithangal Rs 10; Narasamangalam Rs 15 and Sothiyampakkam Rs 10.

Source: Field survey data, 1992.

significant to water supply. Also well farmers and segments (usually different tail-end of channels) which face inadequate and uncertain supplies seem to pay more attention to field channel maintenance so that available supplies are used quite effectively.

Water Allocation

The above account shows the nature and extent of user involvement in the maintenance of the inlet channels and distribution networks. The other aspect of tank irrigation management is allocation of water from the tank to different villages and its distribution within the *ayacut* in normal and deficit supply periods. The allocation of water between different segments of the *ayacut* of both tanks is in the first instance determined by the opening and closing of sluices. This is under the control of the tank superintendent — an employee of the PWD. But he functions on the basis of requests (*yadas*) made by the delegates representing the villages served by the tank. Within the *ayacut* the fact that sluices are at different elevations introduces an element of automatic rationing. A sluice cannot draw water when the storage falls below its sill level. Therefore lands served by the deepest sluice gets more assured water for a longer time than those under elevated sluices.

In KPT, sluices operate independently; but in DMT the elevated sluices are opened first when tank supply is adequate; the deeper sluices are opened when supply in the elevated supply stops. Once a sluice is opened, it is kept open and water allowed to flow continuously except for maintenance or when there is heavy rain. Entitlements of villages/branch canals and modes of diversion specified in the *Mamulnamas* (which codify traditional rules in this regard) govern the intra-channel allocation. The devices used are mainly *kondams* across channels to raise water level to reach elevated land and *mattus* (masonry diversion structures) which automatically regulate flow into branch channels as per customary entitlements. The rules are quite intricate and detailed, but are monitored and enforced (though mutual accommodation and compromise) by *neerkatties* of concerned villages, the villagers view their operation to be broadly in conformity with the *Mamulnamas*.

Our farm level survey gives a detailed picture of the way water is managed by the *ayacutdars* within the villages and whether or not they actually followed any rationing system during the tank supply period. Data have been collected on (i) the conditions of tank water supply in terms of adequacy and reliability in two crop

991-92

(Cash in Rupees; Labour in Mandays)

Field channels			Total contribution				Imputed value		Contribution for main/ branch channels only	Imputed value	
o of farmers participated			Own labour	Labour only (9+17+23)	Converted into cash	by sample farmers (25+18)	% of labour contribution (25/26) X100	for all farmers in the *ayacut* (26/3)X4	Per hectares (28/4)		for all farmers in the *ayacut* (30/3)X4	Per ha (31/4)
1	2	3										
20	21	22	23	24	25	26	27	28	29	30	31	32
			0	5	75	75	100	75	15.7	45	45	9.4
			0	13	195	195	100	1,019	103.6	150	784	79.7
1			1	17	255	255	100	546	48.3	165	353	31.3
								1,641	63.2		1,183	45.6
2	1	5	19	40	400	400	100	1,388	48.4	180	625	21.8
1	7		15	41	410	410	100	3,089	139.3	210	1,582	71.3
			0	11	110	110	100	246	33.1	90	201	27.0
								4,724	81.0		2,408	41.3
2	3		8	17	255	255	100	529	40.7	75	156	12.0
2	2		6	18	270	270	100	1,022	60.7	120	454	27.0
1			1	9	135	135	100	867	58.9	105	675	45.8
								2,418	54.3		1,285	28.8
	4	2	14	36	360	540	67	1,516	52.2	400	1,123	38.7
1	4	1	12	37	370	400	93	1,724	112.7	280	1,207	78.9
1	5	2	17	41	410	465	88	835	87.9	295	530	55.7
								4,075	**75.7**		**2,860**	**53.1**

seasons, namely, the second (October to January) and the third (February to May) in the latest two supply years (1991-92 plus KPT 1988-89; DMT 1989-90); (ii) how inadequacies were managed; (iii) the irrigation practices at field level both in normal and scarcity periods; and (iv) specific problems faced by the farmers to irrigate lands.

Tank Water Supply, 1991-92

Data codified and presented in *Table 5.11* show that in most of the villages under both tanks the majority of respondents reported getting adequate and regular supply (in the second season namely, October to January). Inadequate but regular supply was reported mostly by the tail-end *ayacutdars* in two villages each in both the tanks. Among them, the most affected farmers were in Alapakkam under KPT and Punaithangal under DMT. In both these villages inadequacy mainly toward the end of the season — was met by using own or purchased well water. "No supply" responses were mostly from the tail-end villages. Respondents in the fourth group (water was available but not used) were negligible.

In the third season the pattern is significantly different. All farmers in Kattalai in KPT and a majority in Vagai and Narasamangalam in DMT (the entire head of the deep sluices) reported adequate/regular supply. A substantial segment in Panniyur and Athipattu under KPT and Narasamangalam and Sothiyampakkam reported inadequate but regular supply. All the farmers in Kadaperi and Alapakkam, and a sizeable proportion in Athipattu and Sothiyampakkam did not receive tank supply. In Panniyur some report that supply was available but not used. It is clear that the worst affected farmers were in the tail/elevated sluice villages; and within the village, the less fortunate farmers are the tail segment farmers without wells. The worst affected was Sathiyampakkam.

Farmers adopt several means to cope with inadequacy of water. Those who own wells generally use their well supply to supplement tank water when the latter is inadequate. A few of them also purchase well water from others. During the third season, when shortage of tank water is more widespread, well owners take more frequent recourse to supplement tank water with well water.

Purchase of well water by non-well farmers to meet inadequate tank supply is relatively infrequent in the second season being largely confined to one of the survey villages (Alappakkam). The incidence of

purchased well water was more in the second season, notably in the tail-end villages. A sizeable proportion of tail-reach farmers in KPT (Alappakkam) and DMT did not raise any crop due to water shortage in the second season. The frequency of this response was considerably higher and covered more villages during the third season. Switching from paddy to less water intense and shorter duration crops and purchase of water from tanks in neighbouring farmers (who do not require tank water due to their well supply) are also reported by a few farmers as a way of coping with shortage of supply.

Apart from the problem of inadequacy of supply,

Table 5.11: Conditions of Water Supply in KPT and DMT, 1991-92

Tank and sample villages	No.of sample HHs by type	Reliability of supply								Period of inadequacy					
		Season 2				Season 3				Season 2			Season 3		
		AR	IR	NS	AU	AR	IR	NS	AU	OT	LT	TS	OT	LT	TS
KPT															
Kadaperi	Well 8	8							8						
	Head 8	8							8						
	Tail 8	8							8						
Panniyur	Well 8	6			2		1	6		1				3	3
	Head 8	6			2			6		2					6
	Tail 8	8						3	2	3					3
Kattalai	Well 8	8					8								
	Head 8	8					8								
	Tail 8	8					8								
Alapakkam	Well 8		8						8			2	6		
	Head 8	1	7						8				7		
*1	Tail 8		8						8			4	4		
Athipattu	Well 8	3	3		2		3	2	1	2		3	2		
	Head 8	7		1			4	2	2				2		
*1	Tail 8	4	2	1	1			5	2	1	2		1	2	2
DMT															
Vagai	Well 2	2					2								
	Head 8	8					8								
	Tail 8	8					8								
P Thangal.	Well 8	3	3	2			3		5				3		
	Head 8	7	1				7		1				1		
	Tail 8		3	5			3		5				3		
N Mangalam.	Well 8	8					5	3				3			
*1	Head 8	7	1				4	4					1		4
*1	Tail 8	7	1				7	1					1		1
S Pakkam.	Well 8	6		2			6		2					6	
*3	Head 8	8						2	6					2	
*3	Tail 8	8						2	6					2	

Note: RELIABILITY OF SUPPLY: AR = Adequate/Regular; IR = Inadequate/Regular; NS = No supply; AU = Water was available, but not used.
TS = Throughout season inadequate supply only was available, tank water alone was not enough for cropping.
METHODS OF RESOLVING INADEQUACY OF SUPPLY: (Note: The numbers in heading denote the possible reasons attributed by the sample farmers in each categor
MP = With regard to specific problem we have taken only the major problem that the respondents faced.
*1 and *3 refer to the joint ownership of wells as reported by one, three respondents respectively.

Source: Field survey data, 1992.

a considerable proportion of respondents faced some specific problems which were mainly related to agronomic and locational factors. These include lack of drainage, delay in receiving supply, illegal lifting of water for irrigation, land getting submerged when the local tank reached FTL, and encroachment on the entire channel resulting in no tank supply. These problems are grouped and indicated under four sub-headings in *Table 5.11*. During the second season a large proportion of villages (mostly in the head reaches of the selected sluices) in both the tanks report drainage problems, while among tail-end villages delayed supply was a

Methods of resolving inadequacy of supply																	Specific problems faced							
Season 2									Season 3								Season 2				Season 3			
2	3	4	5	6	7	8	9		1	2	3	4	5	6	7	8	9	NP	DS	DG	MP	NP	DS	DG	MP
		2	6										8					4		1	3	8			
			8										8					3		3	2	8			
		2	6										8					1		5	2	8			
	1		5	1					6				2					6			2	7			1
			8							1			2	2	3			6			2	6			2
			8							1	3		2		2			6	2			8			
			8										8					6		2		6		2	
			8										8					6		2		6		2	
			8										8					3		5		3		5	
5	3												8					5	3			8			
	5		1	1				1					8					2	6			8			
1	3						4				1		7						8			8			
7			1						7				1					7	1			7	1		
			8							2			6					8				7	1		
	1	2	4	1					1	2	3			2				5	3			5	3		
			2										2							2					2
			8										8					1		7		1		7	
			8										8					1		7		1		7	
8										1			7						2	4	2	4		2	2
			8										8					2		6					8
	5		3								5		3					5	1	2		5	1	2	
			8							3			5					8				8			
1			7							1	1		4	1		1		4		4		4		4	
1			7							1			7					4		4		8			
6			2							8								2	3	1	2	6			2
1			7							1	1	4		1	1			5		3		8			
2			6							1	1	6						6	1	1		8			

PERIOD OF INADEQUACY: OT = One to Two months supply only was available at the beginning; LT = Last one to two months supply was inadequate.
1 = Using own well water; 2 = By purchased water; 3 = Not cropped fully; 4 = *Ragi* crop against paddy.
5 = Problem was not faced; 6 = Poor supply/drainage problem leads to low yield; 7 = As a result of pest attack water was not used after 2 months' cropping; 8 = Rainfall + Short duration crops + Cooperation by farmers to maintain channels, all those helped to get some yield.
9. Shortage was adjusted by the local Arakkaneri tank supply + local Thamarai Kulam pond water + Purchased Murai water at Rs 15/hour.
SPECIFIC PROBLEMS FACED: NP = No problem; DS = Delay in supply; DG = Drainage.

frequent complaint. During the third season, drainage is the most frequently cited problem in head reach villages (Kattalai in KPT and Vagai and DMT) also in the tail end of DMT. The absence of field channels is the major contributing factor.

Regarding specific problems, especially drainage, all the head reach villages (irrespective of type) were worst affected. The problem was more intense in the second season than in the third. The problem of drainage was attributed mainly to the non-existence of field channels and the widespread practice of "surface-flooding" irrigation. The scrutiny of the village maps in regard to the magnitude of the availability of field channels clearly shows the non-existence of field channels in two of the head reach villages (Vagai and Narasamangalam) in DMT, and existence of field channels in most of the KPT villages. This was corroborated by the direct visits to these village *ayacuts*.

Tank Water Supply in KPT, 1988-89

In the preceding supply year (1988-89) when the storage level was about 29 feet in KPT, all the well farmers and about half of the head and tail-reaches in Kattalai reported getting adequate and regular supply in the second season. In the remaining villages only a few farmers received adequate supply, and majority of the farmers reported getting inadequate/regular supply. While inadequacy is mostly felt during the last month of the season, some experienced it even from the start of the season. There is, however, no clear pattern. In the third season, except Kattalai, no village received the tank supply. Even here some reported getting inadequate though regular supply. In the third season Kattalai alone received the tank water. For others the question was not relevant.

In the second season a sizable number of head and tail segment of non-well farmers in all the villages (except Kattalai and Alapakkam) reported loss of yield due to inadequate supply. In the third season non-well farmers were unable to resolve the scarcity problem in all the villages. Only those who owned wells could manage to some extent. The majority reported no specific problems in the second season. tail-reach villages reported delay in supply during the second season. In the deep sluice village of Kattalai, drainage was a significant problem.

In DMT, in the preceding supply year (1989-90) storage was only eleven feet. Unless the tank reached over 18 feet storage the sample villages will not get the tank supply, hence DMT was not taken for the analysis.

Field Irrigation Practices

In order to study the methods of irrigation information was sought from the sample households on the method that they normally followed in each season to irrigate lands and their participation in collective management for sharing tank water during normal/scarcity periods. The survey indicated three types of irrigation *(Table 5.12)*: (1) Field-to-field; (2) Using field channels; and (3) *Eravai paichal.*

Field-to-field method is practiced most widely in the DMT villages and to a lesser extend in upper reach KPT villages. The incidence of this method is the highest in Vagai followed by Punaithangal. The method is used where field channels were not available and tends to be more frequent among non-well farmers in the tail segment of the village *ayacuts*. But this practice leads to drainage problem and loss of productivity.

Irrigation using field channels is nearly universal among well farmers. Well water everywhere is costly, and their supply being scarce in tail-end villages, farmers are more careful about using well water. A large majority of non-well farmers in KPT villages and in Narasamangalam and Sothiyampakkam served by the Mamandur sluice of DMT are also reported using field channels.

Eravai paichal is a method by lifting water manually from the supply channel. Usually practiced where the land is located at a higher elevation than the channel, it is rarely used in the villages surveyed, but being reported by eight of the sample farmers.

During the survey year (1991-92) the large majority of sample farmers in selected villages of both tanks experienced no scarcity in the second season and therefore did not need to practise any form of *murai*. For a few who did not raise any crop *murai* was irrelevant. During the third season farmers reported *murai* being followed only in one village (Panniyur). In most other cases there was either no scarcity (Kattalai under KPT and Vaigai/Narasamangalam under DMT) or land was not cropped due to lack of water. But farmers in one village (Alappakkam) under KPT cited non-cooperation as the reason for not adopting it.

By and large, the data corroborate the expectation that well farmers in all the villages are better placed than non-well farmers; head reaches are better placed than tail-enders; and the farmers located at the tail segment of particular villages experienced more difficulty in getting adequate and assured supplies. These differences must ultimately be reflected in the productivity of land.

Productivity of Land

Since the quantum and assurance of water supply has a significant influence on productivity, one would expect that production per ha of *ayacut* area would be higher (a) in farms with wells than those without wells; (b) in the head reach than tail-end villages; (c) farmers whose

Table 5.12: Irrigation Methods Followed in the Sample Villages in KPT and DMT, 1991-92

Name of tank and sample villages	Sample HHs by type	HHs which did not follow *murai* in normal supply period		HHs which followed in 1991-92		HHs which did not follow *murai* in 1991-92 and reasons						Methods of irrigation for all seasons			
						Season 2		Season 3							
		Season 2	Season 3	Season 2	Season 3	No scarcity	Not cropped	Non-cooperation	No scarcity	Not cropped	No tank supply	FF	FC	EP	OS
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
KPT															
Kadaperi	Well 8	8	8	0	0	8	0	0	0	2	6	1	6	1	0
E (H)	Head 8	8	8	0	0	7	1	0	0	7	1	1	7	0	0
	Tail 8	8	8	0	0	8	0	0	0	8	0	5	3	0	0
Panniyur	Well 8	8	8	0	8	7	1	0	0	0	0	0	7	0	1
E (H)	Head 8	8	8	0	6	6	2	0	0	2	0	2	4	0	2
	Tail 8	8	8	0	3	8	0	0	0	5	0	1	7	0	0
Kattalai	Well 8	8	8	0	0	8	0	0	8	0	0	2	6	0	0
D (H)	Head 8	8	8	0	0	8	0	0	8	0	0	0	8	0	0
	Tail 8	8	8	0	0	8	0	0	6	2	0	4	4	0	0
Alapakkam	Well 8	8	8	8	0	0	0	0	0	2	6	0	8	0	0
M (T)	Head 8	8	8	8	0	0	0	0	0	7	1	1	7	0	0
	Tail 8	8	8	8	0	0	0	0	0	7	1	0	8	0	0
Athipattu	Well 8	8	8	0	0	8	0	8	0	0	0	1	7	0	0
D (T)	Head 8	8	8	0	0	7	1	6	0	2	0	0	8	0	0
	Tail 8	8	8	0	0	8	0	5	0	3	0	2	4	0	2
DMT															
Vagai	Well 2	2	2	0	0	2	0	0	2	0	0	2	0	0	0
E (H)	Head 8	8	8	0	0	7	1	0	8	0	0	7	0	1	0
	Tail 8	8	8	0	0	8	0	0	7	1	0	7	1	0	0
Punaithangal	Well 8	8	8	0	0	8	0	0	2	2	4	6	2	0	0
E (T)	Head 8	8	8	0	0	6	2	0	8	0	0	8	0	0	0
	Tail 8	8	8	0	0	3	5	0	3	5	0	5	2	0	1
Narasamangalam	Well 8	8	8	0	0	8	0	0	8	0	0	0	6	2	0
D (H)	Head 8	8	8	0	0	8	0	0	8	0	0	4	4	0	0
	Tail 8	8	8	0	0	8	0	0	8	0	0	4	1	3	0
Sothiyam Pakkam	Well 8	8	8	0	0	8	0	0	0	0	8	0	6	1	1
D (T)	Head 8	8	8	0	0	8	0	0	0	4	4	3	5	0	0
	Tail 8	8	8	0	0	8	0	0	0	6	2	1	7	0	0

Note: Column 12 refers to crop raised by using well water; HHs = Households. Method of irrigation: FF = Field-to-field.
FC = Using field channels; EP = *Eravai paichal;* OS = Others — Submergeable land, not cultivated and no supply available.
E (H) = Elevated sluice head reach village; D (H) = Deep sluice head reach village; D (T) = Deep sluice tail-reach village.
M (T)= Middle sluice tail-reach village; E (T) = Elevated sluice tail-reach village.

Source: Field survey data, 1992.

lands are largely in the head segment compared to those in the tail segments of *ayacut* within each village; and (d) in years of normal supply than in years of scarcity. These expectations are amply borne out by the survey data.

Table 5.13 presents estimates of the gross value of crop production per hectare of area held by the farms in the selected villages in the *ayacut* for two years: 1991-92 which is more or less a normal year and the most recent previous year in which tank supplied some water: 1989-90 in KPT and 1988-89 in DMT. Both happen to be below normal years.

In both tanks, in both years, in most villages the average output per ha of *ayacut* is highest among well farms and lowest among tail segment non-well farms. The difference between well and non-well farms in DMT villages is more pronounced in the scarcity year than in the normal year and in the tail-end villages than in the head reach. In KPT the head-tail difference in this respect is pronounced in 1991-92 but not in 1989-90. Nor is the differential between well and non-well farms always higher in the scarcity year than in the normal year.

Among well owning farmers, differences in productivity between villages under head reach and tail-end were much smaller than among non-well farms. In fact in 1991-92, the head-tail difference in this respect is insignificant in both sluices of DMT; while in KPT the tail-end well farmers in fact got considerably higher productivity than in the head reach villages. Inter reach differences are more pronounced in below normal years; not only is overall productivity lower, but unlike in 1991-92, the level in tail-end villages is less than in head reach villages under the same sluice.

Among non-well owners, those in the head segment of individual villages have higher productivity than those in the tail segment in all but one village in 1991-2 and all but 2 in the preceding supply year. The differentials are in general larger under DMT than in KPT, and in below normal years compared to normal years.

Across villages, in most cases (except the Mamandur sluice of DMT in 1991-92), non-well farms in the tail-end achieved lower productivity per hectare of *ayacut* than those in the head segment. The pattern is different in the case of head segment non-well farms. In 1991-92, a year of normal supply, tail segment non-well farms in all KPT villages and in one of the sluices of DMT had lower productivity than in the head reach villages. This pattern is also observed in both sluices of DMT in the previous — below normal — supply year; however in KPT productivity of non-well farms in two of the head reach villages are lower than in the tail end villages.

Output per hectare of *ayacut* is the product of two elements: cropping intensity and production per unit of cropped area: Cropping intensity in selected DMT villages is in most cases highest on well farms, followed by non-well farms in the head segment and finally non-well farms in the tail segment. In DMT, this progression

Table 5.13: Productivity of Different Categories of Farms in Selected Villages of KPT and DMT

Tank and villages	Well farms				Non-well (head) farms				Non-well (tail) farms			
	CI		GVO/ayacut		CI		GVO/*ayacut*		CI		GVO/ayacut	
	t1	t2	t1	t2	t1	t2	t1	t2	t1	t2	t1	t2
KPT												
Kadapperi	118	148	12,198	14,329	96	80	7,322	7,594	102	103	7,495	8,044
Panniyur	165	202	12,921	18,563	81	170	5,512	15,238	111	170	7,314	13,981
Kattalai	208	276	20,623	22,610	173	213	15,588	17,257	100	207	9,110	17,220
Alapakkam	155	197	13,710	22,742	151	124	13,648	13,611	56	97	3,676	6,790
Athipattu	153	228	13,855	28,434	119	118	9,395	11,659	124	154	5,057	10,461
DMT												
Vagai	186	296	15,167	17,609	87	279	4,392	16,032	83	264	3,811	13,917
Punaithangal	126	212	11,750	18,174	63	217	3,044	17,347	25	76	696	5,593
Narasamangalam	133	256	8,682	22,912	79	249	2,903	18,568	38	231	1,244	11,706
Sothiyampakkam	116	220	8,426	22,488	66	162	3,466	16,163	14	146	802	12,600

Note: CI = Cropping Intensity = (gross crop area/*ayacut* area) X 100; GVO/ayacut = Gross value of production in rupees per ha of *ayacut* area. (GVO/*ayacut*)/CI = GVO per ha of gross cropped area; t1 = 1989-90 for KPT and 1988-89 for DMT; t2 = 1991-92 for both tanks.

Source: Farm Level Survey, 1992.

is noticed in 3 of the 4 villages during 1991-92 and all of them in 1988-89. Among KPT villages, a similar progression is seen in the normal year (1991-92) but only in 2 during the scarcity year. In Dusi, cropping intensities and output per gross ha show a progressive fall from well farms to non-well head to non-well tail. This shows that within a given village, those farms which have less water and less assured water tend to cultivate their land less intensively and also get lower production per cropped ha.

Comparisons across villages are problematic. But confining comparisons to villages served by the same sluice, it is noteworthy that in both tanks and years, and all 3 categories of farms tail-end villages have lower cropping intensities than those in the head reach. By contrast, there is no consistent pattern in the variation of output per gross hectare. The latter is lower in the head reach compared to the tail-end in practically all cases during the normal year. But in the scarcity year the head reach gets more per cropped hectare in several instances. On the whole, this suggests that variations in quantum and assurance of supplies affect productivity mainly through cropping intensity. It would seem that faced with scarcity of water, those disadvantageously located invariably cultivate a smaller proportion of their land and to raise fewer crops in a year, but in many cases manage to get as good, and sometime better value per hectare of cropped area.

Production per ha of operated area is, not surprisingly, higher in the normal year compared to year of scarcity *(Table 5.14)*. This difference is relatively smaller in all three categories of land in Kaveripakkam villages than in DMT; the difference is less in the head reach and tail-end villages served by the same sluice: and the impact is the highest among non-well farms with land concentrated in tail segment of each village. In all cases, the impact of scarcity is felt predominantly in cropping intensity. Yield per cropped ha do not always fall; and even when it does accounts for a relatively small fraction of decline in output. Clearly scarcity has a markedly greater impact on tail-end villages and in the tail-end tank (DMT). Thus location and access of well water largely determine the outcome.

Factors Responsible for Productivity Variation

The overall productivity of the sample farms depends upon cropping intensity (CI) and the value of output per hectare of gross cropped area) (GCA). These two are affected by a number of factors, which can be broadly grouped into two: (1) Technical and (2) Institutional. Since we have already discussed the effect of institutional factors in greater detail, the importance of technical factors influencing productivity is discussed here.

The most important among the technical factors are: (a) conditions of water supply; (b) drainage conditions and (c) soil quality. Among these the conditions of water supply are the most important followed by drainage conditions. *Table 5.15* presents, in summary form, the water supply conditions and agricultural performance of the overall *ayacut* in selected villages during 1991-92 and the deficit supply year. It brings out considerable variations within each tank in the

Table 5.14: Difference between Normal Year (1991-92) and Below Normal Years in Productivity Indicators in the Selected Villages of KPT and DMT

Tank and villages	Ratio of value in 1991-92 to corresponding value in previous supply year								
	Well farms			Non-well (head) farms			Non-well (tail) farms		
	CI	GVO/GCA	GVO/*ayacut*	CI	GVO/GCA	GVO/*ayacut*	CI	GVO/GCA	GVO/*ayacut*
KPT									
Kadapperi	1.25	0.94	1.17	0.83	1.24	1.04	1.01	1.06	1.07
Panniyur	1.22	1.17	1.44	2.10	1.31	2.76	1.53	1.24	1.91
Kattalai	1.33	0.83	1.10	1.23	0.89	1.11	2.07	0.91	1.89
Alapakkam	1.27	1.31	1.66	0.82	1.21	1.00	1.73	1.07	1.85
Athipattu	1.49	1.37	2.05	1.00	1.25	1.24	1.24	1.67	2.07
DMT									
Vagai	1.59	0.73	1.16	3.21	1.14	3.65	3.18	1.15	3.66
Punaithangal	1.68	0.92	1.54	3.44	1.65	5.70	3.04	2.68	8.04
Narasamangalam	1.92	1.37	2.64	3.15	2.02	6.40	6.08	1.54	9.41
Sothiyampakkam	1.90	1.49	2.67	2.45	1.90	4.66	10.43	1.48	15.71

Source: Computed from Table 5.13.

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Table 5.15: Productivity of Sample Holdings and Some Related Characteristics in KPT and DMT in the Normal and Below Normal Supply Years

Tank and sample villages	% of drainage facility	Latest supply year							Preceding supply year						
		Tank water supply months	% of area using well water	GVO/ GCA —— Rs ——	GVO/ NSA	CI (6/5)	GCA ha	GCA reporting use of well water (ha)	Tank water supply months	% of area ha using well water	GVO/ GCA (ha)	GVO/ NSA (ha)	CI (13/12)	GCA ha	GCA reporting use of well water (ha)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
KPT															
Kadaperi E (H)	75	5	33.3	9,291	10,925	118	75.6	25.1	4	78.6	8,990	9,699	108	71.9	56.5
Panniyur E (H)	80	6	16.6	8,988	16,900	188	130.7	21.8	4	29.3	7,504	10,043	134	80.2	23.5
Kattalai D (H)	40	9	18.1	8,208	20,563	251	760.7	137.6	7	44.4	9,677	17,418	180	538.6	239.0
Alapakkam M (T)	95	4	74.3	10,713	17,339	162	281.6	209.2	6	48.5	8,560	10,843	127	240.3	116.5
Athipattu D (T)	90	8	70.6	11,423	22,649	198	522.2	368.8	6	73.5	8,110	11,551	142	389.4	286.1
DMT															
Vagai E (H)	0	8	6.7	5,637	15,730	279	176.5	11.8	0	21.8	6,763	8,454	125	66.4	14.5
P.thangal E (T)	50	8	40.9	8,329	15,128	182	282.9	115.6	0	69.7	8,266	7,458	90	128.5	89.5
N.mangalam D (H)	40	8	24.7	7,807	19,453	249	269.7	66.6	0	67.5	5,522	5,396	98	89.3	60.3
S.pakkam D (T)	80	5	60.5	9,853	18,590	189	253.1	153.2	0	86.6	6,880	5,405	79	111.4	96.4

Note: E(H) = Elevated sluice head reach village; D(H) = Deep sluice head-reach village. M(T) = Middle sluice tail-reach village; D(T) = Deep sluice tail-reach village. E(T) = Elevated sluice tail-reach village; GVO = Gross value output. GCA= Gross cropped area; NSA = Net sown area; CI = Cropping intensity; Latest year, 1991-92; Preceding year, KPT 1988-89; DMT 1989-90.

Source: Field survey data, 1992.

availability of tank supply, extent of well irrigation and incidence of drainage problems, and gives some insight with their effects on productivity.

Thus in KPT, Kattalai is best placed in terms of access to tank water (it got nine months supply in 1991-92 and seven months in 1988-89); but had little well irrigation — especially during normal supply period — and a major part of its land faced drainage problems. The latter two (well irrigation and drainage) depresses yield per gross hectare, but given the long duration of tank supply, it had the highest CI and the secured gross value output (GVO)/net sown area (NSA). Athipattu is a tail-end village, but being fed by deep sluice, got almost eight months supply in 1991-92 and had considerable well irrigation, which accounts for a higher yield per gross hectare and also a relatively high CI resulting in the highest GVO/NSA in all the five villages. Alapakkam, being at the tail of the middle sluice is less well placed in access to tank water, but best placed in access to groundwater. Yield per hectare of GCA is relatively high but CI is low which depresses overall productivity. Clearly access to well water in these cases helps to compensate to a considerable degree the consequences of unequal access to tank supplies on account of location.

Kadaperi, despite being at the head, got only five months supply because it was fed by an elevated sluice; also access to well irrigation is much less compared to tail-end villages; cropping intensity is therefore very low and GVO/NSA is the lowest among the selected villages. Panniyur is also served by an elevated sluice and has the least access to groundwater. But, being served by a sluice which is located slightly deeper than that of the Kadaperi's Gaffor sluice; it gets tank water for a somewhat longer time. This makes for higher cropping intensity and consequently GVO/NSA is higher.

Compared to 1991-92, water supply in 1988-89 was poor in all the villages, but the reported distribu-

tion was best in Kattalai; the reduction in yield per hectare of NSA (entirely due to less intense use of land) is also the least in this village. In the other two head-reach villages (Kadaperi and Panniyur) a substantial increase in area using well water was insufficient to compensate for shortage of tank supply leading to a reduction in both CI and GVO/NSA. This is most marked in Panniyur. In the two tail-end villages (Alapakkam and Athipattu) reduction in tank supply was aggravated by a reduction in the area using groundwater leading to a near half of GVO/NSA.

In DMT, which has little well irrigation, productivity per GCA is generally lower than in KPT for comparable reaches even in good year like 1991-92; cropping intensities are much higher (mainly on account of the practice of growing broadcast paddy in June-September and also because three of the four villages got eight months supply). Consequently, production per ha of *ayacut* is comparable to KPT.

In DMT, GVO/GCA is lower in the head reach villages because of severe drainage problems and also because of the use of groundwater, which is, much less than in the tail-end. Head reach villages having more assured access to tank water compared to the tail-end, also achieve higher CI. Inter–reach variations in tank supply, drainage and groundwater seem largely to compensate each other, thereby narrowing the difference in GVO/NSA. As may be expected, productivity per hectare of operated area is somewhat higher in the *ayacut* of the deeper Mamundur sluice which has the added advantage of greater access to groundwater.

A year of poor tank supply (as 1989-90) results in a steep reduction of CI, and in the yield of area cropped. Overall GVO/NSA falls by between 60 and 75 per cent as a consequence. It needs noting that unlike KPT in 1988-89, when the tank was only three feet short of FTL, DMT had barely 11 feet storage in 1989-90 (compared to FTL of 31'); it was also a year of severe drought. A large portion of the *ayacut* was left uncultivated and cropping depended entirely on groundwater. The total area, which could get groundwater, declined sharply.

Aggregate output in the below normal year was much lower than in the normal year in all villages: In KPT the reduction was highest in Athipattu (the tail-end of its sluice), and Panniyur (head of an elevated sluice) and the least in Kattalai at the head of the deepest sluice. In DMT, where the previous supply year was much worse than in KPT, the reduction ranged between 78 and over 90 per cent being somewhat more pronounced in the deeper sluices but more or less the same degree between head and tail villages under each sluice.

CONCLUSION

This survey of KPT and DMT shows that though the formal organisations may seem to be in disarray and despite changes in the patterns of land ownership, technology and rural power structure which tend to weaken institutions of collective action, the essential functions of maintenance and water allocation continue to be managed by the communities benefiting from the tanks. A corpus of custom and tradition guides these activities; and there is sufficient interest and involvement on the part of both the *ayacutdars* and the village leadership to ensure that they are carried out. We have seen that participation and contribution to maintenance of networks and local irrigation functions is widespread, the value of their contributions (mostly in the form of labour and payments to village irrigation works) ranging from Rs 65 to Rs150 per ha.

Unevenness in this respect is in large measure attributable to the water availability in the tank and the prospects of particular segments of the *ayacut* getting large or more assured supplies through better maintenance. Activity is more in times of normal supply than in years of scarcity. Customary practices of rationing in periods of scarcity are followed in many cases. But no attempt is made to rethink or rework the rules in the light of changed cropping systems, agricultural practices and irrigation technology. The spread of well irrigation — partly due to increase in number of wells and more importantly their energisation has weakened community management. Clearly, well farmers are better placed in terms of access to water; productivity and less affected by scarcity. Non-well farmers are not as well placed; those at the tail-end of the distribution system being worst-off even in normal years. Impact of scarcity is also greatest in this category. Location and access to groundwater are thus the prime determinants of the extent and quality of irrigation. The allocation mechanisms do not address, or at any rate are ineffective, in ensuring fair and equitable distribution of available supplies to the *ayacutdars*. ■

Notes:

1. Documents written during 1815 setting down the traditional rules and regulations for augmentation and distribution of tank water.

2. For details on methodology adopted for selection of sample villages and sample farmer households for the survey, see *Sivasubramaniyan* 1995.

Chapter 6

CONCLUSIONS AND IMPLICATIONS

A Vaidyanathan

The material presented in the preceding chapters suggests that many of the current perceptions about the state of tank irrigation, the problems it faces and the remedial measures to improve their effectiveness need to be questioned and reassessed. We have seen that the available official statistics on tanks are inadequate, inconsistent and confusing. There is not even an authenticated count of the number of tanks and of the extent of area irrigated by them. Practically nothing is known about the quantum of water supply, its seasonal distribution and reliability, the extent to which they have changed and the factors, which have contributed to it.

Our surveys of specific tanks are limited to two basins and the selected tanks may not necessarily be representative of those in these basins. The scope and level of detail of the information on technical and institutional aspects obtained is certainly far from adequate. Being confined to PWD tanks, it does not tell us much about the far more numerous *panchayat* and ex-*zamin* tanks. However, since the PWD tanks account for the bulk of the tank irrigated area and considering that the basins as well as the tanks studied capture a wide variety of situations (in terms of agro-climatic conditions, size, location, source of supply, and reliability) the findings do provide a better authenticated picture of the ground reality. They also have important implications for the future strategy for this sector.

In the first place, it is significant that none of selected tanks in the Periyar-Vaigai as well as the *Palar* basins has become physically derelict or defunct. All of them are functioning, but their physical condition is in most cases dilapidated.

The inlet channels of most tanks surveyed in Periyar-Vaigai and Palar basins are found to be silted and/or encroached; tank *bunds* are damaged and weak; sluices and shutters are missing or non-functioning; and tanks beds are silted. In several cases surplus weirs are damaged and some report foreshore encroachment. The incidence of physical damage however varies being more frequent in non-system than system tanks and in the Palar basin than in Periyar-Vaigai. The nature and extent of damage also varies among tanks in each basin. Generalized uniform packages of improvement are therefore inappropriate. The needed physical improvements will have to be tank specific and this will require detailed tank by tank investigation.

A large majority of tanks report siltation. *Ayacutdars* even offer estimates of its extent in their tanks. But these are highly impressionistic and therefore not reliable. The PWD has attempted such estimates for several tanks (not included in our sample). But these are also not systematic enough to be reliable. For instance, a Planning Commission report (prepared in the late 1950s) concluded on the basis of data provided by the state PWD in respect of 125 tanks that "... sixteen tanks had silted more than 50 per cent, fifty one tanks between 25 and 50 per cent, fifty tanks between 10 and 25 per cent and eight less than 10 per cent." (GOI, PC, 1959; cited in MIDS, 1986). The methodology for assessing the extent of siltation is not indicated or discussed. A proper assessment requires detailed contour surveys of the tank bed at different points of time. Such surveys have not been done. The PWD did conduct a survey to ascertain the storage capacity of 28 tanks in the seventies. But nothing can be inferred about changes in capacity from these data as no similar surveys had been done earlier in any of them. Nevertheless, one cannot altogether discount the impression of knowledgeable *ayacutdars* that a large proportion of tanks are silted in varying degrees and that there has been a general reduction of effective capacity.

Taken together with the reduction in the quantum of inflow due to deterioration of inlet channels and encroachment of natural drainage channels, it seems reasonable to infer that the volume of water available for

irrigation has fallen. The evidence however is not conclusive: information provided by knowledgeable villagers regarding the duration of water supply available from each of the selected tanks during the last 3 years suggests that there was no significant difference between rated and actual supplies in Periyar-Vaigai. While in Palar the actual duration is frequently reported to be less than their rating. But in as much as the concept of "duration of supply" is fuzzy and there are no reliable measures even of the levels of storage achieved in various years, leave alone quantum of water let out into the *ayacut*, such impressionistic accounts need to be treated with caution. On the other hand the fact that inlet channels are found to be narrowed, silted and encroached indicates that the capacity of these channels and hence the volume of supplies flows into the tanks has been significantly reduced.

If siltation and reduced inflow through inlet channels are significant, one must expect a significant reduction in the area actually irrigated crop compared to the registered *ayacut*. The available evidence does not quite corroborate this expectation. A PWD study (conducted in the 1970s) of tanks located in different parts of Tamil Nadu showed that area actually irrigated during the 10-year prior to the survey was equal to, or in excess of, the registered *ayacut* (mainly for a single crop of paddy but also including some area under sugarcane) in seven cases; while in three tanks actual irrigation was less (and in one case substantially less) than the registered *ayacut*. A third study covering 3 tanks, showed actual area irrigated to be equal to the registered *ayacut* in two cases and short of it in one (*Vaidyanathan*, 1984). Of the 76 tanks surveyed in this study, the *ayacut* as per-revenue records, (which seem likely to be closer to the reality on the ground), was higher than the PWD figure in as many as 22 tanks. The difference is more than 20 per cent in 13 of them. The revenue records figure was lower than the PWD in 16 cases, the difference exceeding 10 per cent in 12 of them. Interviews with knowledgeable *ayacutdars* of selected tanks show that none reported any reduction in effective *ayacut* over time; some in fact reported an increase.

This apparent inconsistency between changes in water supply and area irrigated may to some degree be explained by the following factors: First, reduction in supplies from the tank is to some extent offset by the spread of well irrigation in their *ayacuts*. By recycling part of the seepage from distribution channels and the fields this increases the proportion of gross supplies from the tank which is effectively used for crops in the *ayacut*. Second, reduced supplies may have induced changes in crop pattern and irrigation practices, which are less water intensive. While these are plausible, any judgments on their extent and impact can only be speculative. Reliable measurements of area irrigated (by season and crop) in the tank *ayacut* are simply not available. The importance of more careful and systematic monitoring of water use, area irrigated and crop patterns cannot be over emphasized.

The more so because the situation is far from uniform across tank and regions. For instance, our surveys show significant differences in all these respects between system and non-system tanks. The physical conditions of non-system tanks and associated structures being markedly worse compared to those of system tanks. A larger proportion of non-system tanks get water for less than 3 months and report higher inter-year variability. There are also marked regional differences: the tanks (both system and non-system) in Periyar-Vaigai basin are in better physical condition and get a longer and more assured supplies compared to those in the Palar basin. There are, however, fewer wells relative to *ayacut* area in the PVB tanks. The differences between system and non-system tanks are more pronounced in PVB than in *Palar* basin. A particularly important finding of the present (and earlier) field studies is that local community arrangements for tank management continue to function in a large majority of cases.

Prima facie, given the massive shifts in the social composition of land owners (from numerically small upper caste to more populous middle and lower castes), increase in demographic pressure, weakening of local power structure and the spread of well irrigation during the last several decades, one would expect these institutions would have become weaker. Surprisingly, however, local institutions are reported to be currently defunct only in five out of the 76 tanks surveyed: A sizeable number, 24 out of 76, reported having done some work by the *ayacutdars* to clean/repair inlet channels in the last three years; in a large majority of cases, the maintenance/repair of distribution networks in the *ayacut* have been done by *ayacutdars* contributing cash or labour; most have functionaries (especially *neerkatties/thotties*) to attend tank management under the supervision of village leadership. In half the tanks the value of contribution (in labour and cash) for these maintenance activities range during 1994-95 exceeded Rs 25 per hectare, and in about a third of them are more than Rs 50 per hectare. These obviously bely the widespread belief that traditional community institutions for tank management have generally become dysfunctional or even collapsed.

The overall functioning of community institutions has been rated on the basis of a simple (perhaps over-simple) system of assigning point scores depending on whether specified functions (repair/maintenance of inlet channels, tank structures and distribution

networks, existence of irrigation functionaries; and practice of water rationing) are performed by the community and how frequently. On this basis, against a maximum permissible score of 16 points, only 4 had a zero score. These may be considered defunct; 21 out of 76, which scored 1 to 5 points, must be rated as weak. But as many as 28 had a score of more than 10 points, pointing to fairly strong and active institutions.

Interestingly, there are systematic differences between the two basins and between system and non-system tanks in each basin *(Table 6.1)*. On our system of rating, the community institutions in tanks of Palar basin are distinctly weaker than in Periyar-Vaigai: More the half of the former are "weak" and all the four "defunct" institutions are in this basin. In PVB no institution is defunct and only two are "weak", while nearly two thirds are "strong" (10 plus points), compared to a mere sixth in Palar. The relative frequency of strong institutions is higher among system than among non-system tanks of PVB. The differences in this respect are less marked in Palar: the proportion of "weak" institutions is not very different as between the two tank categories, while that of "moderately active and "strong" is somewhat more among non-system tanks.

We are not in a position to satisfactorily explain the reasons for these systematic differences. However, the following features are suggestive: Tanks in PVB, on the average, get supplies for a longer duration, have fewer wells and their tanks seem to be in somewhat better physical condition. In Palar basin the physical condition of tanks is markedly worse, well densities are much higher and tank water is available for a shorter duration (in a majority of cases for less than three months). Under these conditions community action for tank management is unlikely to make as much of a difference to quantum and assurance of water supplies. On the other hand, the wider access to groundwater in Palar (and possibly more ample supplies thereof compared to PVB) reduce the incentive for collective effort and resources securing tank supplies.

DEVELOPMENT STRATEGY

The programmes for tank irrigation in recent decades have been inadequate in scale, misconceived in design, poor in implementation and dubious in their impact. Irrigation development has been dominated by large surface works and groundwater exploitation. They have absorbed most of the investment in this sector. Allocations for small surface irrigation, of which tanks are the most important, have been quite meager by comparison and also in relation to the needs of this segment. Most of the effort has concentrated on improvement of existing tanks. Only a fraction of these have been covered. There is no coherent overall strategy and well-defined priorities reflecting the relative potential of different types of tanks and different regions. Schemes are designed without adequate preparatory surveys and unmindful of the differences in the needs and possibilities between tanks. The schemes are planned piece meal without recognising the inter-connections between tanks and/or tanks with larger systems or the necessity for improving the natural drainage system of their catchments. There has been little concern for cost effectiveness. Costs are inordinately high in relation to expected benefits, which are highly exaggerated. Objective measurement of actual impact is seldom done. Indeed if official data are to be believed, the area under tank irrigation has declined in absolute terms. The tendency to replicate the command area approach to tanks and to rely on extensive lining of

Table 6.1: Comparison of Physical Conditions and Water Supply Characteristics in Selected Tanks of Periyar-Vaigai and Palar Basins

River basin	No of tanks	Working of institutions mean score No < 10	No of tanks reporting					Duration of water supply average of 3 years		Min/ max > 80%	Well density
			Encroachment within inlet channel	Weak/ broken *bund*	Damaged surplus weirs	Damaged and repair in sluices	Silted tank-bed	< 3 months	> 4 months		
Periyar Vaigai											
System	15	11	7	10	7	10	8	0	7	8	18
Non System	21	12	17	16	12	18	15	7	9	9	14
Palar											
System	18	2	18	14	6	16	15	13	0	3	44
Non System	22	3	17	21	5	21	21	16	0	6	49

Source: Survey 1995.

channel and on-farm development works greatly adds to the costs. The effectiveness of the current approach to restoring the capacity of existing tanks, expanding them and increasing productivity of land irrigated by them is thus in serious doubt.

There is both scope and need for a major re-orientation of approach and strategy towards tank irrigation. Larger outlays will of course be necessary to arrest the declining trend in tank irrigation. But it is far more important to make sure that the improvement works are so planned as to (a) augment the quantum and reliability of water supplies to existing tanks; (b) exploit the possibilities of using tanks (including where feasible by construction of new tanks) in conjunction with large canal systems; (c) ensure that the nature and magnitude of investments for improving water use efficiency are tailored to the needs of specific situations and in a cost effective manner. All this calls for far-reaching changes in the organization and management of the programme.

AUGMENTING WATER SUPPLY

Clearing encroachments and removing silt from inlet channels and removing obstructions to natural drainage are meant to restore the capacity of tanks to designed levels. Current programmes do recognise this but their effectiveness is severely limited by the government's reluctance to take firm action for removing unauthorised blockages and encroachments; and put a stop to illegal tapping of water from these channels. Without this, other measures to augment supplies to tanks are unlikely to be effective.

De-silting of tank beds to increase effective storage capacity is the other main instrument for improving water supply. The extent of removal of siltation is by all accounts prohibitively costly. Use of silt to raise the level of foreshore lands is a possibility; but this often runs into problems of clearing encroachments. Another possibility is to use the silt from tanks beds to restore soil cover on degraded land as part of watershed development programmes. But whether these would be economically justified in terms of additional production from degraded lands needs careful assessment before de-silting is given a prominent place in the programme for tank rehabilitation.

The supply of water to tanks and percolation ponds can be increased by measures to reduce soil erosion, restore vegetative cover on upper slopes and retain as much of the local rainfall as is possible in the soil and in surface and sub surface storage within each micro watershed. Improvement of tank irrigation must therefore be seen as an integral part of watershed development.

Additional supplies from outside the catchment area of a particular rain-fed tank, or chains of them, is the fourth possibility: In the case of existing system tanks, this may require modernising the *anicuts* (and associated structures) feeding them, improving distribution channels, linking existing non-system tanks to (or constructing new tanks in the command of) larger canal systems. Essentially, this implies converting more and more of the existing tanks into system tanks which can have the benefit of supplies from a much wider catchment than their own and therefore have larger and more dependable supplies per unit of *ayacut*. Moreover, the existence of such subsidiary storage make for greater flexibility and provide more scope for farmer participation in the management of canal water which in turn helps more efficient and productive use of surface irrigation.

In Tamil Nadu (and to some extent in Karnataka) a large number of tanks are already linked to and integrated with larger canal systems. The Tambraparani, the Vaigai and the Palar basins are some of the outstanding examples. But this tradition seems to have been largely ignored in the planning of new major irrigation projects. Indeed there are instances (eg. Sriram Sagar Project of Andhra Pradesh) where even pre-existing tanks in the command of large canal irrigation projects cannot augment their supplies from the canal, not to speak of developing new tanks. There are also instances (eg., the Sarhda canal in Uttar Pradesh) where the introduction of canal irrigation has led to the displacement of pre-existing local works (including tanks) without substantially increasing the area irrigated. The precise scope for augmenting supplies to tanks by linking them to larger canal systems and for constructing new system tanks in their command cannot be judged without detailed investigation. It is also bound to differ from region to region. What we need is a conscious effort to explore and exploit this possibility. This naturally requires planners to view canals and tanks in a given region as complementary and not as separate categories.

Some people argue for a radical shift of emphasis from relatively large storage based irrigation (which dominates current plans) to small local works like tanks. The latter, it is claimed, are superior from the technical, economic and environmental viewpoints. This argument is not of much relevance in Tamil Nadu where practically all the utilisable surface water resources have already been exploited. But it is highly questionable even in those parts of the country where large unexploited surface water is available. From a technical viewpoint, small storage has necessarily to depend on rainfall in their own catchments. The quantum and seasonal pattern of availability as well as reliability of supply to the storage cannot, therefore, be very different

from that of local rainfall. Under Indian conditions, where rainfall is highly concentrated in three-to-four months period and the rest of the year is relatively dry, tanks depending solely on the yield of their catchments cannot make much of difference to the volume, duration and reliability of water supply.

Tanks, though large in terms of number, have an aggregate storage capacity, which is quite small relative to the cultivated land. The 2,50,000 tanks in the country can store only 15-20 billion m3, capable of irrigating no more than 2 per cent of the cultivated area. The potential of tank irrigation, the technology for which has been in vogue for centuries, was exploited earlier and more fully than larger storage which is essential to tap the surplus flows over a wider catchment. Except for the perennial rivers of the north, and areas with large, independent reservoirs of groundwater, this necessarily calls for relatively large storage to carry over the surplus monsoon rainwater from the relatively high rainfall regions. Without large storage it would not have been possible to increase storage capacity by over 200 billion m3 during the last 4 decades.

Viewed exclusively as alternatives to large modern storage, tanks are also at a disadvantage in terms of costs and benefits. Even if investment cost per hectare of *ayacut* is lower than in large storage - and the evidence of experience challenges this assumption - the advantage is neutralised when allowance is made for the relatively high rate of evaporation losses in the storage per unit of water available, high ratio of area submerged by storage to the *ayacut*, the high rate of depreciation and the relative inferiority of tanks (compared to large storage) in terms of quantum, duration and reliability of supplementary water supplies. In large parts of India, large and small storage (and storage vis-à-vis groundwater) is more appropriately viewed as complementary to each other rather than alternatives.

Planning for small scale surface irrigation also needs to differentiate between tanks with very small *ayacuts* (the *panchayat* union and ex-*zamin* tanks are good examples) depending on rainfall in their direct catchments, and the relatively larger tanks draining supply for a wider catchment either because they are part of a chain or become they are linked to larger canal networks. Improvement of the former, and increasing their number, is best achieved as part of integrated micro-watershed development programmes based on local community effort. The latter require more complex engineering, involve larger investment and need to be viewed as part of wider irrigation networks extending over larger areas. They are best planned and managed as part of the integrated programmes for improving management of surface and groundwater under large canal system and river basin.

IMPROVING WATER USE

Augmentation of water supply needs to be accompanied by measures to achieve more efficient and equitable water use. "Efficiency" is a function of several factors: the proportion of water supplied by tanks which is effectively available for crops; the crop patterns; and the extent to which quantum and timing of irrigation is adjusted according to crop water needs at various stages of growth. Currently, tank modernisation programmes are primarily concerned with the first aspect: and that too to a limited extent. There is a heavy emphasis on lining of distribution channels in tank *ayacuts* as a means of reducing the seepage loss in conveyance. Besides increasing the effective supplies it is expected to ensure smoother, faster flow of water to the tail end. Combined with the introduction of rotational supply of water within the *ayacut*, lining is supposed to improve both efficiency and equity. However, little is known about how much of a difference lining has actually made in these respects and whether the gains are commensurate with the costs. Apparently, no scientific studies of this have been done.

In any case lining is not appropriate in all situations, nor is it the only one. There are alternative techniques of reducing conveyance losses (e.g., by using earthen pipes) and for increasing the proportion of tank water, which is available to crops (notably through conjunctive use of ground and surface water in the *ayacut*). The latter has spread quite widely but very unevenly. However, their implications for appropriate redesign of distribution networks is hardly ever taken into consideration. Where conjunctive use is already widespread, groundwater recharge through seepage will be adversely affected by lining of channels. In which case the net gain in irrigation efficiency would be less than the gross gain. Furthermore, even as lining of channels and conjunctive use improves water use efficiency in a particular *ayacut*, it may have adverse effects — via reduced regeneration flows — on downstream *ayacuts*. The potential for different techniques of raising irrigation efficiency as well as their costs and consequences being far from uniform, it is quite wrong to adopt a standard package. The measures must be differentiated to suit varying conditions of tanks.

The eventual impact of improved water supply on production depends on how water is used: specifically what crops are grown, how well the timing and quantum of application of water is adjusted to crop water needs, and how careful farmers are in irrigating their fields. These aspects of water management receive far too little attention in current programme. Rotational irrigation — which is about the only element of regulated water management incorporated in the

programme — is far from adequate and may even be inappropriate. Improving water management has to address rules in operation of land and water allocation within the *ayacut*, and their effective enforcement.

Most tanks, as we have seen earlier, have some well defined conventions evolved over a long period of time such as the opening and closing of sluices, allocation of water to different segments of the *ayacut*, and rationing rules in times of scarcity. Though based on custom and tradition, they are quite specific, detailed and seem to be generally (though not universally) recognized by *ayacutdars* as reasonably fair. They have, and continue to provide, the framework for a reasonably stable and orderly functioning of tank irrigation. However, the rules need to be reworked in the light of changes in the conditions of water supply in the *ayacut* (e.g. when a non-system tank becomes a system tank or when groundwater irrigation in the *ayacut* has become significant), crop patterns, agricultural techniques and agrarian structure, as well as better understanding of crop water yield relation. Changes in water allocation rules and effective institutions for implementing them is thus crucial to raising the productivity of tank irrigated lands.

This is both technically complex and socially difficult. The technical problem difficult enough when one is dealing with pure tank irrigation becomes far more so in the context of multiple sources of water supply and changing technology. In so far as changes in allocation rules affect the current relative positions of farmers — and this is only to be expected getting a general consensus on desirable changes is not easy. When the effects of changes are uncertain-whether for lack of knowledge or for other reasons-resistance will be greater. The chances of getting a general consensus are improved if it can be demonstrated that the changes will increase overall productivity and most, if not all, users, can expect with reasonable confidence to improve their individual positions. For this reason, changes in rules can be easier to negotiate when it accompanies an increase in the quantum and reliability of water supply.

The situation in all these respects obviously varies a great deal between tanks. No outside agency, like the PWD, is really equipped to comprehend these diversities and suggest rules appropriate to specific tanks; even less to monitor and enforce their compliance on the contrary any attempt to bring about major changes in allocation rules precipitously, through an outside agency, is unlikely to succeed.

Instead of concentrating exclusively on physical improvements to the distribution network — whose necessity and effectiveness is in any case open to question–state agencies should devote more attention to providing information, technical expertise and advice to the user communities to explore and discover better ways to use water. They and NGOs should focus more on encouraging and helping to understand the present status of water supply in terms of sources, uses and inter-farm allocations; the possible ways in which, in the specific context of each tank, the existing and augmented supplies could be better used for raising productivity and the implications for different segments of the command. Given the inherent complexity of the problem, one has to allow for a period of trial, error and learning before a technically sound set of new rules acceptable to the user community can be formulated.

ORGANISATIONAL ASPECTS

Implementation of the approach outlined above calls for far reaching changes in the way tank improvement programmes are planned and implemented. The current practice of viewing tanks as a separate category for purposes of irrigation planning and preparing improvement schemes for selected tanks taken individually should be given up. Instead the planners should view the problem as one of the harnessing and effective use of available water from tanks and other sources, mindful of their inter-relation both on the side of supply and of use. This means that planning for improvement of existing tanks and construction of new tanks should be (a) viewed as part of an integrated plan for development of land and water resources in predominantly rain-fed areas on a watershed basis; and (b) in areas commanded by major and medium irrigation works, as part of an overall plan for using canals, tanks and groundwater in a coordinated manner to secure optimum use of available water supply in the command.

The first essential step towards integration is to pool the resources allotted for land and water development projects of an essentially local character. This includes all of minor irrigation, soil and moisture conservation, social forestry and afforestation of the upper catchment. Secondly, all the elements must be made part of an integrated land and water development plan starting with the micro-watershed and moving progressively though macro watershed and sub-basins up to the river basin; and, in the case of minor irrigation, integrated with major and medium works wherever relevant.

This integration has to be achieved in all phases: namely, collection of the basic data necessary for preparing a package of interventions according to the potentials and problems specific to each watershed; and implementing the package in as efficient and cost effective manner as is feasible. The basic unit of such planning must be the watershed and/or the command area of the canal systems. The rational course in respect of system tanks would be to make the authority, which

plans the construction/improvement of each major and medium project also, responsible for development of tanks in its command. In the case of rain-fed tanks, the construction and improvement of tanks (and other minor irrigation works) should be planned and implemented in conjunction with soil conservation and social forestry in a unified manner at the watershed level.

Integrated watershed development is now widely accepted and has become the official policy. But for the most part the watershed projects are far from "integrated" even in concept and more so in practice. The responsibilities for soil conservation, restoration of adequate and appropriate vegetative cover in the upper catchments, development and use of water from canals and wells are handled independently of each other and of tank irrigation. Programmes for minor surface works are designed and executed independently of major and medium works while wells are largely left to the private sector. The fragmentation of effort inherent in the existing arrangements is compounded by the tendency for each of these activities to be included under numerous special programmes, (for a more detailed discussion see *Vaidyanathan*, 1999).

Proper watershed planning must articulate the treatments in terms of the nature of vegetative cover for the upper parts of the catchments; the kinds of structures (*bunds, nullah plugs*, check dams, terraces) necessary to control the flow of rain water; the determination of the appropriate uses of land of different slope and elevation categories; and the location and scale of percolation ponds. In doing so, the availability of water from outside the watershed through canals and surplus from upstream watersheds must also be taken into account. The nature of the interventions appropriate in respect of each of these and their inter-relation necessarily varies from region to region, indeed from watershed to watershed.

An essential first step for improving the quality of tank development programmes is to prepare a complete inventory of tanks and collate available information on their condition. A considerable (though inadequate) amount of technical data on PWD tanks is available in the PWD records (*Tank Memoirs* and more recent investigations conducted for tank modernisation) but very little on the current state of water supply and use. These data remain scattered and often inaccessible or not easily retrievable even by concerned government agencies. Information on non-PWD tanks is very scanty. The Minor Irrigation Census conducted in the eighties can be used to get a list of the villages, which have non-PWD tanks. Remote sensing could be used to verify, speedily and at reasonable cost, whether the tanks listed in the PWD and village records are currently impounding water and how much area is irrigated. But this will need to be supplemented by additional field surveys to ascertain in more specific detail their present conditions and problems.

The second task is to prioritise regions/tank types for drawing up a phased programme of tank improvement. In terms of area covered, the PWD tanks clearly are far more important than non-system tanks. However, if the number of communities benefited and their spatial dispersion were the criterion the non-system tanks deserve greater attention. An area-wise prioritisation (with watersheds as the units) and planning the development of all categories of tanks in each area is essential for integrated development. The extent of damage/siltation, the area and population likely to be benefited and the potential impact in terms of increased quantum and assurance of water supply and, ultimately, increased output and employment are the main considerations, which should guide this decision. Given the inadequacies of currently available data, there must be room for revising the priorities in the light of more and better information.

Based on these considerations, a phased programme of detailed surveys to assess the present condition of all tanks in the state can be undertaken. The findings of these surveys will help identify the scope for improvement and/or extension of tanks and the engineering works and other measures needed to exploit it. Both these functions call for specialised technical expertise. Therefore the constitution of survey and planning teams staffed by suitably trained technical personnel, in the water resource organisation and in district level organization for integrated watershed development is essential.

At the same time, it needs to be recognized that these tasks cannot be performed effectively by such expert organisations on their own, the survey and planning teams must work in close interaction with individual tank and village communities and collectively with representatives of tanks which get supplies from the same watershed or area linked to a common external source. This is necessary both to take maximum advantage of the detailed, first hand knowledge of field reality available in the concerned communities in designing schemes, make sure that they understand the rationale of the proposed improvements and are convinced that improvement works will make the community, and its members, better off than before.

This process must begin even at the stage of compiling the basic data necessary for planning. The current practice of relying entirely on the concerned departments is both expensive and extra-ordinarily times consuming. Besides collecting whatever information is available in the concerned departments and through field surveys, there is much to be gained by

enlisting the villagers help in compiling the relevant information.

A great deal of first-hand knowledge of the local situation, accumulated from experience, is available in each locality / region. This is especially valuable in identifying major problems and even prospective solutions appropriate to the specifics of each situation. It provides the basis for a meaningful interaction between the technical experts and the affected communities regarding the kinds of improvements needed the problems (especially social), which may arise and how they could be overcome. Of course a considerable amount of the information (on quantum of water available, conveyance and application losses, quantum of recycled water, crop water needs etc.) need to be collected.

In order to save time and cost and to prepare the ground for meaningful interaction between farmers and those in-charge of designing the improvement works, a conscious effort needs to be made to utilise available expertise outside the government (NGOs, retired personnel and even consultants) and evolve mechanisms for involving local engineering/agricultural college faculty and students in technical investigations and selected people from the irrigation communities for compiling information specific to their localities. It will be necessary for government and non-government experts in each district to train and supervise selected members from each tank village to compile the relevant information. The skills necessary for this purpose can be, over a period of time, imparted to persons with a high school level education. Higher level experience in the government and academic institutions can play a supporting role in their training and in helping with the analysis and interpretation of data; exploring with members of the village community the feasibility of various interventions and clarifying their implications; and helping to reconcile conflicting interests of different communities.

Ideally, the local communities should be given active role in construction of works, and required to acquire a direct stake in the scheme by contributing a part of the cost. Such an arrangement will not only enable the work to be done more cheaply and more quickly, but also ensure that affected villages (for whose benefit the programme is meant) are better informed about the possibilities and the problems of their environment so that they can take an effective part in deliberating on the available options. This process of interaction is even more essential to formulate rules for efficient use of available water based on a better understanding of the rationale of the needed changes and their acceptance by the affected groups as being fair and reasonable. Without this, the effectiveness of the interventions is likely to be seriously compromised.

Experience has shown, time and again, that measures to improve the management of land and water introduced by state agencies fail not only because they are planned piecemeal and without tailoring them to the need of specific situations, but because the enforcement of the discipline regarding land use, water allocation and maintenance of the common facilities through the bureaucracy is singularly ineffective. And it turns out to be very expensive. The state agencies must therefore, concentrate on creating an ambiance and a framework in which the affected communities can explore, in an informed and transparent way with the support by expertise from the government and NGOs, the nature of the improvements needed and evolve a package which is generally acceptable. The primary responsibility for enforcing the appropriate regulations — concerning land use, water allocations — on a continuing basis must be vested in the communities. The State's role must be to evolve criteria and procedures by which inter-community conflicts and questions concerning "fair distribution" of common resources serving a wide area can be resolved. ■

APPENDIX 1

METHODOLOGY ADOPTED AND SCHEDULE USED FOR THE SURVEY OF TANKS UNDER THE PERIYAR-VAIGAI AND PALAR BASINS

I. Methodology

The Periyar-Vaigai and the Palar basins are among the most tank-intensive tracts of Tamil Nadu. They differ significantly in agro-climatic conditions. And within each basin there are considerable variations in physical conditions, organisation and management. We have designed the study to capture variations across system and non-system tanks of different sizes and in different locations in each basin.

Available data on the tanks and tank irrigation in each basin, information on the number of system and non-system tanks and their distribution by size of *ayacut*, storage capacity, duration of water supply and number of wells in the *ayacut* were collected from the records of PWD. This provides an overall picture of the spatial distribution of tank irrigation, its importance as a source of irrigation, and variations by size and source of supply within each basin. These data have been compiled for various *taluks* which comprise the basins. Though the data are generally incomplete and there are questions about their reliability, they are useful, if approximate, basis to see whether there are any coherent patterns of variation in characteristics as between different segments of the basin, between system and non-system tanks and tanks of varying sizes.

The taluks falling in each basin were grouped into three categories, namely, those located in the head, the middle and the tail segment of the basin. (The salient features of this computation in respect of the two basins are detailed in the relevant chapters). Tanks located in each of these zones were divided into system and non-system tanks.

For purpose of detailed field survey, keeping in view of time and benefit contrast it was decided to cover 20 system and 20 non-system tanks in each basin. We did not attempt any rigorous sampling for selecting the specific tanks to be surveyed. The effort was to ensure that tanks falling in different points in the spectrum defined by the reach, size, nature of tank were captured. Within each group, defined on the basis of the above characteristics, selection was purposive, being influenced by considerations of logistical convenience both for investigators and the supervisors.

During the visit to the selected villages, information concerning the registered *ayacut* as per revenue records, the area and crops irrigated and the number of wells in the *ayacut* of the selected tanks were obtained from the records of the village administrative officers. These records are not always complete and upto date. Their reliability is also a matter of some doubt. But this is the best available source at present.

The conditions of the inlet channels, tank *bunds*, sluices and surplus weirs were ascertained by investigators actually visiting the tank site and inspecting it. The village leaders, knowledgeable farmers and local functionaries concerned with the tanks were identified and interviewed individually as well as in groups to elicit information on various aspects of the organisation and working the tank management. A structured questionnaire, reproduced at the end of this Appendix, was used to get information on the main features of the local organisation for tank management; the functionaries involved, their appointment and remuneration; details of maintenance and repairs undertaken by the PWD and by *ayacutdars* in the recent years; nature and extent of community participation/contribution; conditions of water supply and management of water allocation; and problems as perceived by *aycutdars*. Where possible, information regarding changes in conditions of water supply, institutions and the working was also collected. On the average it took two-three days to complete this work in each selected tank.

By using a structured schedule and interviewing knowledgeable local people, it has been possible to obtain a lot more of first hand information on the characteristics of tanks and their management in different type of situations than is currently available in official records. It also permits meaningful comparisons of characteristics between tanks. However a rapid two-three day survey is inadequate to assess all relevant features of the conditions of the tanks, especially on the extent of siltation, the quantum and duration of water supply, the precise manner in which rules for collective management operate and the way they get adapted to changing situations; the incidence of conflicts and their resolution. This would call for systematic observation and measurement, involving considerable technical expertise, and conducted over a period of time. Any assessment of the impact of irrigation on land use, cropping patterns and yield would require detailed surveys of farmers, which were preluded by time and resource constraints. Such a survey was however done in two large Palar tanks and the results are reported in Chapter 5.

II. Schedule

STUDY OF INSTITUTIONS AND VARIATIONS IN THEM IN TANK IRRIGATION UNDER VAIGAI/PALAR BASIN

1. Basic Details

Tank Name:	**Village:**	***Zone/Taluk:***
System/Rainfed:	If system, source of supply: If rainfed, isolated/chain:	
Registered *ayacut:* (hectares)	Single or multi–village tank:	

If multi-village tank, details:

Sl no	**Village name**	***ayacut* (hectares)**	**Extent of land under (hectares)**	
			Single crop	**double crop**

2. Water supply conditions in the tank for the last three years

	Details	**1994-95**	**1993-94**	**1992-93**
a.	Date of release			
b.	No of fillings			
c.	Duration of supply (months)			

Is there any difference in water supply condition between head and tail-reaches of the *ayacut*. If so when and why?

Is there any problem with upstream tank/village *ayacutdars* in getting water supply? If yes, details.

3. Wells in Nanjai

No. of wells in the *ayacut* and their concentration area:

Effect of wells on the tank operation in terms of maintenance and water allocation:

4. Cropping pattern in the last three years:

Crop	**Area under (hectares)**		
	1994-95	**1993-94**	**1992-93**
Rice			
Sugarcane			
Banana			
Coconut			
Other irrigated dry crop			

5. Conditions of physical structures of tanks:

a)	Inlet channel	: Good/encroached/silted/
b)	Tank *bund*	: Good condition/breaches
c)	Tankbed	: Silted heavily, not much siltation/encroached
d)	Sluices	: Control structure good/poor condition
e)	Surplus weir	: Good/poor condition

Any increase or decrease in the *ayacut:* yes/no, If yes details

Detail	**Extent (hectares)**	**Reasons**
Decrease		
Increase		

6. **Structure of irrigation organisation:**

Irrigation organisation at the tank level:

Who are the persons involved in the management of the tank?

Functionary name	Caste	Land holding (hectares)	Position	Active/Less active/ Inactive

Method of selection of irrigation functionaries, period, their duties and remuneration

Organisation at the village level:

In the case of multi-village tank, find out the functionaries involved in each village and their background:

Name of village	Name of functionary	Caste	Landholding (ha)	Position	Active/Less active/ Inactive
1.	a)				
	b)				
	c)				
2.	a)				
	b)				
	c)				
3.	a)				
	b)				
	c)				
4.	a)				
	b)				
	c)				
5.	a)				
	b)				
	c)				

Details about method of selection of village level functionaries, period, their duties and remuneration:

Irrigation workers:

Find out details about irrigation workers who implement the decisions of management such as *kammukutti/neerkatti/thotti* etc:

(Number of workers, mode of employment (hereditary) periodicity; their background in terms of caste and land holding, their duties and remuneration, sanctions for negligence of duties etc).

Funds maintained by organistion: amount, sources, and purpose of utilisation:

Tank level: _____

Village level: _____

7. Repairs and maintenance:

Repairs

Does the PWD maintain inlet channels, tank structures in proper condition? If yes, details about repairs undertaken in the last five years?

If no, major problems faced due to neglect of these works

Do the *ayacutdars* undertake any repair works themselves regularly/occasionally?

If so, details of the work, cost involved and source of fund in the last five years.

Do the villagers do any thing to get more supply to the tank (digging inlet channel, organised representations to PWD etc.) If yes, details of specific instances.

Maintenance:

Details of maintenance works undertaken in the tank by *ayacutdars*

Work particulars	No. of times during last 5 years	1994-95 work details				
		No. of times	Labour (mandays)		Cash contribution (Rs)	Rate of labour/ cash	Extent of participation
			Own	Hired			
a) Inlet channel							
b) Main/ branch channel							
c) Field channel							

Penalties for non participation:

8. Water allocation:

Responsibility for opening/closing/adjusting sluices and the basis:

If water supply in the tank is inadequate at the time of sowing, is there any collective attempt at regulating the area of crop sown and timing of sowing. If so details:

In normal times, i.e., when supply is adequate, is there any method for allocation of water? If yes, details:

In case of shortage of tank supply, method of water allocation:

Method	Yes/No	When was it last implemented?
a) *Murai* system		
b) *Oru* madai paichal		
c) Tail-to-head		
d) Others		

Deatils about implementation of the system in the latest year and how it worked?

Disputes:

Details about disputes in allocating water within *ayacut*/appropriation of water to the tank/others. If so, how resolved?

9. Any significant changes in the conditions of tank, supply of water, cropping pattern, institutional arrangements etc. during the last two decades.

APPENDIX 2

METHOD ADOPTED FOR PERFORMANCE RATING OF TANKS

This Appendix explains the procedure used for rating the physical condition, the functioning of community management and conditions of water supply and water allocation of selected irrigation tanks.

I. Physical Condition

For evaluating the physical condition of the tank we consider the state of inlet channel, the tank *bund*, the tankbed, sluices and control structures and the surplus weirs. The basis for scoring of each tank is given below:

	Scores
1. Inlet Channel	
If the inlet channel is good and free from encroachment and siltation	2
If the inlet channel is either encroached or silted	1
If the inlet channel is both encroached and silted	0
(Note: we have not taken into account the intensity of encroachment/siltation but considered whether the encroachment/siltation affect the flow of water to the tanks)	
2. Tank *Bund*	
If the tank *bund* is good and free from breaches, depressions and encroachment	2
If the tank *bund* is either encroached or depressed	1
If the tank *bund* is both encroached and depressed	0
3. Tankbed	
If the tankbed is not silted up heavily (40% or more of siltation) and not encroached	1
If the tankbed is silted up heavily and encroached	0
4. Sluices and Control Structures	
If all the sluices and control structures are good	2
If 75 % of sluices and control structures are good	1
If most of the sluices and control structures are damaged or having no shutters	0
5. Surplus Weir	
If all the surplus weirs are good	2
If 75 % of sluices and control structures are good	1
If most of the surplus weirs are weak/breached	0

II. Functioning of Institutions

1. Number of times when maintenance was done either by PWD or *ayacutdars* in the last five years.	
If 1 to 3 times good work is done	1
If 4 to 5 times good work is done	2
If more than 5 times good work is done	3
2. Number of times when repair was done by PWD and/or *ayacutdars* in the last five years.	
No work done	0
Work done in one year	1

	Work done in 2 to 3 years	2
	Work done in 4+ years	3
3.	**Number of functionaries**	
	Supervisory level:	
	Presence of *ambalam* and/or *nattanmai*	1
	Lower level: Presence of irrigation workers:	
	1 person for more than 40 ha	1
	1 person for less than 40 ha	2
	If there is no *ambalam/nattanmai* or lower level workers	0
	Prevalence of Rationing:	
4.	**Method adopted to overcome shortage of supply at the end of the supply season**	
	Oru madai paichal/*Murai*/Strict supervision	1
	Farmers themselves adjust the available supply	0

III. Conditions of Water Supply and Water Allocation

1.	**Duration of Water Supply**	
	Average number of months water supply available from the tank to the *ayacut* in the last 3 years divided by maximum number of months supply available to the *ayacut* in a year (across reaches).	
	If 1 to 3 months supply is available from the tank	1
	If 3 to 5 months supply is available from the tank	2
	If 5 + months supply is available from the tank	3
2.	**Well Density**	
	For well water use two types of data are used.	
	For PVB tanks, the percentage of area getting well water is taken into account, i.e.,	
	1 to 20 percentage of *ayacut* gets well water	1
	21 to 40 percentage of *ayacut* gets well water	2
	40 + percentage of *ayacut* gets well water	3
	For Palar basin tanks well density criteria are used, i.e., number of wells per 100 hectares of *ayacut*.	
	If well density is 1 to 50 (per 100 ha of *ayacut*)	1
	If well density is 51 to 100 (per 100 ha of *ayacut*)	2
	If well density is > 100 (per 100 ha of *ayacut*)	3
3.	**Variability**	
	Since water availability in the tanks across years varies due to rainfall or depending upon the supply available from source, we took the average for counting variability.	
	If the minimum/maximum range is between 0.01 to 0.40	1
	If the minimum/maximum range is between 0.41 to 0.80	2
	If the minimum/maximum range is 0.80 +	3
4.	**No of months storage available in the tank to release tank water**	
	Only after getting adequate supply in the tanks	2
	Immediately after getting the water supply	2

5. **Normal period water allocation**

As per farmers requirements only *neerpaichies* supply water to the *ayacut*	2
Water can be used liberally by *ayacutdars* themselves	1

6. **Method adopted to overcome shortage of supply at the end of the supply season**

Oru Madai paichal/*Murai*/Strict supervision	2
Farmers themselves adjust the available supply	1

7. **Sluice Operation**

Existence of local organisation+*madaiyan/thotti/lascars*	2
Ayacutdars themselves	1

8. **Imposition of penalty**

If penalty is levied for non-performance of maintenance by *ayacutdars*	1
If penalty is not levied for non-performance of maintenance by *ayacutdars*	0

9. **Caste**

For multi-caste tank village	1
For single caste tank village	2

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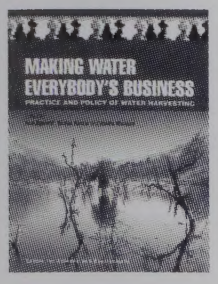
GLOSSARY

Aathalai	Local name of water plants which are seen abundantly in the tankbed, bunds, and in all other places.They restrict/reduce the supply available to the tanks
Adangal	Cultivation account register maintained by the Village Administrative Officer
Adavu Eduththal	One of the methods adopted by the village organisation to collect the fine imposed on the defaulters of maintenance activity
Anicut	A permanent masonry structure to store and/or divert river flows for irrigation
Ambalam	Village headman
Ayacut	Area commanded by an irrigation work
Ayacutdars	Farmers who own land in the *ayacut*
Collector	The head of the revenue administration at the district level
Diversion vents	Vents with specified dimensions constructed to divert water from the main/branch channels
Kammukutti	Hereditary village level irrigation worker
Kavaimaniyam	Village level specialist in canal management
Kaval	Lower level irrigation functionary
Kanmoi	An irrigation tank (in south India)
Kondam	A temporary earthen embankment to raise the water level to irrigate elevated lands
Korambu	A temporary earthern embankment to divert water by using wood and sand bags
Kudimaramath	Traditional community labour participation for the maintenance of irrigation channels
Kuli	66 cents
Lascar	Lower level functionary of the Public Works Department
Madagu	Sluice
Madaiyan	One who operates the sluices. In most tanks his main duty is to divert water to several *madais* to irrigate the ayacut
Magimai	A fraction of amount received by the contractor for any sale of goods from a village to be paid to the village (or *kuthagai*)
Mamulnamas	Documents written during 1815, setting down the traditional rules and regulations for augmentation and distribution of tank water in North Arcot
Maniagar/Maniyam	Village headman

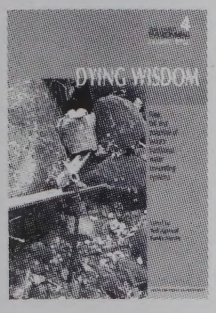
Manthai	Village common area where people generally assemble during their leisure time
Marakkal	Local measure for grains, equivalent to 4.52 kg of paddy
Mattu	A masonry structure from which a specified dimension of two or more channels take off to supply water to the *ayacut*
Tank Memoir	A government record which provides all technical details pertaining to a tank
Mirasidari	Land tenure system in which the ryots paid the land tax to the *mirasidar*
Munsif	Village administrator
Murai	A system of fixed time-bound rationing of tankwater supply adopted during scarcity period
Nattanmaikar	One of the village headmen
Neerkatti	A government appointed irrigation functionary to supervise the tank water supply
Neerpaichi	A temporary irrigation worker appointed by the village organisation
Oru madai paichal	Channelwise turn distribution of water supply, practised during the deficit tank supply period
Pattadar	Person who owns a written document, issued by government settling title and land revenue of his land
Ryotwari	A land tenure system in which farmers directly paid land tax to government
Sudanthiram	Compulsory payment made to irrigation workers
Tahsildar	Taluk-level head of the Revenue Department
Thalaiyari	A village revenue functionary to assist the VAO
Thotti or *Toti*	Hereditary village-level peon
Vaai Madai	Irrigation points which are available in each main/branch channel from which water is delivered to the *ayacut*
Yadas	A written slip, for release of a specified quantity of tank water to the *ayacut*, given by the village representative to the secretary of the Irrigation Board or to the union engineer of the PWD
Zamindari	A land tenure system in which the ryots paid land tax to the zamindar

ON WATER



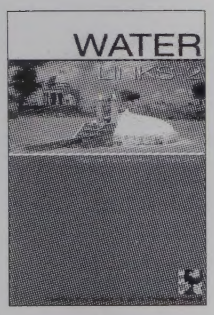
Making Water Everybody's Business: Practice and Policy of Water Harvesting (edited by Anil Agarwal, Sunita Narain and Indira Khurana)

Published in 2001, this book brings you up-to-date with the practices and policies of rainwater harvesting highlighting the work of different governments, non-governmental organisations and community groups in rural and urban areas. (Price: Rs 890 hardback)



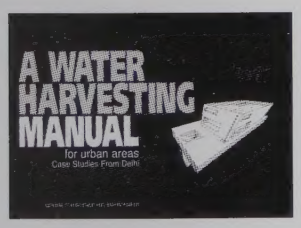
Dying Wisdom: Rise, fall and potential of India's traditional water harvesting systems (edited by Anil Agarwal and Sunita Narain)

Published in 1997, this book provides a comprehensive overview of Indian water harvesting traditions. The book breaks up India into 15 ecological regions and provides a survey of the traditions in water technology and management systems in all these different ecoregions. It took about seven years to produce this book because of the extremely scattered character of the knowledge that existed in this field. The book made people to realise that the water harvesting paradigm is relevant even today. (Price: Rs 290 paperback; Rs 490 hardback)



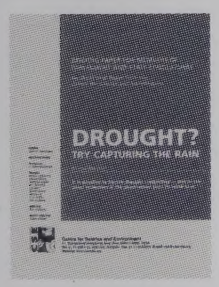
Water Links

This is a directory which presents information about water harvesters and the work they are doing in different parts of India and abroad. First published in 1999, this publication is updated periodically. It keeps people informed about water harvesting activities and experiences in different regions. It is a platform in print that helps experts and activists to get in touch with each other. (Price: Rs 140)



A Water Harvesting Manual for Urban Areas: Case Studies from Delhi

Published in 2000, this manual is built out of CSE's experience in providing technical advice to schools, residential colonies, individual households and factories to implement rainwater harvesting in the urban context. It provides basic information on the need and potential of rainwater harvesting. (Price: Rs 90)



Drought? Try Capturing The Rain (by Anil Agarwal)

Published in 2000 ,this paper presents the potential of rainwater harvesting for drought-proofing India's villages. It urges members of parliament and state legislative assemblies to ensure that the governments take up rainwater harvesting on a large scale to improve local food security. There is enough rainwater in every village of India to meet drinking water needs and critical needs of agriculture. This strategy would complement India's current water management and agricultural strategy which aims at ensuring national food security rather than local food security. (Free)

Catch Water

This is a bimonthly interactive newsletter which provides information on various activities undertaken by water harvesters in India and abroad. It is published as part of CSE's activities as the central secretariat of the National Water Harvesters' Network. It covers campaigns, initiatives, technology, news, policy reports and book reviews. (Free)

The irrigation tanks of south India embody an ancient and rich tradition of harnessing local rainfall and stream flow for agriculture. For long these were the dominant source of irrigation.

The advent of largescale storages and energised pumping have overshadowed these tanks in recent decades. Resources allocated towards maintaining the existing tanks in good condition and construction of new ones is but a small fraction of the outlay on canal systems, wells and tubewells.

The significance of these tanks as successful examples of local effort and community management, their potential in facilitating the flexible and more effective use of resources available when integrated with large water systems have not received adequate recognition. Nor have the lessons these tank management systems hold for successful implementation of community participation in water management.

There are few systematic and detailed studies of the present state of the tanks, how they are managed and how their working has adapted to changing conditions.

Tanks of South India *provides an overview of the evolution and role of tank irrigation in Andhra, Karnataka and Tamil Nadu. This is an attempt to fill the gap.*

The findings are interesting: surveys of selected tanks belie the impression of widespread decay and decline. Though in varying states of disrepair with institutions managing them having changed and even weakened due to demographic pressure, social composition of land ownership and the spread of well irrigation, all the tanks surveyed are operational. Maintenance and water allocation continues to be managed by informal community institutions active in a large majority of them.

Tanks of South India *provides an idea of the variations between and within tanks, in the distribution of water to different segments of the command and in productivity.*

The study confirms that tank communities are active and functioning. That they deserve much greater attention in water resource development.

The book sets out the agenda of action to revive, expand and revitalise these works to achieve better balance between large and small works, and facilitate more flexible, equitable and efficient use of water with user communities playing a central role.

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41, Tughlakabad Institutional Area, New Delhi-110062 Tel: 91-11-608 1110, 608 1124, 608 3394, 608 6399
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